

APPENDIX I

METHODOLOGY FOR CALCULATING MASS-LOAD BASED TMDLs FOR IMPAIRED BEACHES AND CREEKS AND ALLOCATING TO SOURCES

I.1 Introduction

This appendix describes the methodology for calculating the mass-load based Total Maximum Daily Loads (TMDLs) for impaired beaches and creeks and allocating the allowable bacteria loads to sources in each watershed. Calibrated and validated models were used to calculate “existing” bacteria mass loads and “allowable” bacteria mass loads (i.e., TMDLs) in each watershed under a set of critical conditions. Because the climate in southern California has two distinct hydrological patterns (wet and dry), two modeling approaches were developed for estimating bacteria loads.

In the San Diego Region, storms tend to be episodic and short in duration, and characterized by rapid wash-off and transport of very high bacteria loads from all land use types. The wet weather modeling approach used for calculation of existing loads and TMDLs was USEPA’s Loading Simulation Program in C++ (LSPC). LSPC was used to estimate bacteria loading from streams and assimilation within the waterbodies, and specifically quantified loading during wet weather events, defined as 0.2 inches of rain and the 72 hours that follow. LSPC is a recoded C++ version of the USEPA’s Hydrological Simulation Program–FORTRAN (HSPF) that relies on fundamental (and USEPA-approved) algorithms. A complete discussion of LSPC configuration, calibration, and application is provided in Appendix J.

In contrast, bacteria loading under dry weather conditions was found to be much smaller in magnitude, did not occur from all land use types, and exhibited less variability over time. To represent the linkage between source contributions and in-stream response, a steady-state mass balance model was developed to simulate transport of bacteria in the impaired creeks and the creeks flowing to impaired shorelines. This predictive model represented the streams as a series of plug-flow reactors, with each reactor having a constant, steady-state flow and bacteria load. A complete discussion of the development of the empirical framework for estimating watershed loads, and a description of the configuration and calibration of the stream-modeling network is provided in Appendix K. In addition to estimating current loading, both models were used to estimate TMDLs for the two climate conditions for each watershed. Assumptions made for both wet weather and dry weather modeling can be found in Appendix L.

This appendix describes the methodology for calculating existing loads and TMDLs using the wet and dry weather modeling results. Section I.2 of this appendix describes the numeric targets that were used to calculate wet weather and dry weather TMDLs. Section I.3 discusses the use of load-duration curves, which were instrumental in calculating wet weather TMDLs from model output. Section I.4 discusses the derivation of wet weather TMDLs and allocations. Section I.5 discusses the derivation of dry weather TMDLs and allocations.

In all cases, bacteria sources were quantified by land-use type since bacteria loading can be highly correlated with land-use practices. For purposes of implementation, land use practices were grouped according to the most likely method of regulation by the San Diego Water Board of bacteria discharges from the land use type.

I.2 Numeric Target Selection for Wet Weather and Dry Weather TMDLs

When calculating TMDLs, numeric targets must be selected to be able to meet water quality standards (i.e., water quality objectives (WQOs) that ensure the protection of beneficial uses). The numeric targets selected for these TMDL calculations are based primarily on the numeric WQOs for bacteria for the water-contact recreation (REC-1) beneficial uses. Numeric targets applicable to beaches were also used for impaired creeks for the reasons discussed in section 4 of the Technical Report.

Different dry weather and wet weather numeric targets were used because the bacteria transport mechanisms to receiving waters are different under wet and dry weather conditions. Single sample maximum WQOs were included in the wet weather numeric targets because wet weather, or storm flow, is episodic and short in duration, and characterized by rapid wash-off and transport of high bacteria loads, with short residence times, from all land use types to receiving waters. Geometric mean WQOs were included in the numeric targets for dry weather periods because dry weather runoff is not generated from storm flows, is not uniformly linked to every land use, and is more uniform than stormflow, with lower flows, lower loads, and slower transport, making die-off and/or amplification processes more important.

Another difference between the wet weather and dry weather TMDL calculations, besides the use of single sample maximum WQOs versus geometric mean WQOs, is the allowable exceedance frequency of the WQO. The allowable exceedance frequency that is based on using a reference system approach. The purpose of the reference system approach is to account for the natural, and largely uncontrollable sources of bacteria (e.g., bird and wildlife feces) in the wet weather loads generated in the watersheds and at the beaches that can, by themselves, cause exceedances of WQOs.

The reference system approach is included in the numeric target for the wet weather TMDL calculations by allowing a 22 percent exceedance frequency of the single sample WQOs for REC-1. Twenty-two percent is the frequency of exceedance of the single sample maximum WQOs measured in a reference system in Los Angeles County.¹ A reference system is a beach and upstream watershed that are minimally impacted by anthropogenic activities. A reference system typically has at least 95 percent open space.

In contrast to wet weather, the dry weather numeric targets include an allowable exceedance frequency of zero percent. This is because available data show that exceedances of geometric

¹ In the calculation of the wet weather TMDLs, the San Diego Regional Board chose to apply the 22 percent allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County. At the time the wet weather watershed model was developed, the 22 percent exceedance frequency from Los Angeles County was the only reference beach exceedance frequency available. The 22 percent allowable exceedance frequency used to calculate the wet weather TMDLs is justified because the San Diego Region watersheds' exceedance frequencies will likely be close to the value calculated for Leo Carillo Beach, and is consistent with the exceedance frequency that was applied by the Los Angeles Regional Board.

mean WQOs in local reference systems during dry weather conditions are uncommon (see Technical Report, section 4.2). Furthermore, reference systems do not generate significant dry weather bacteria loads because flows are minimal. During dry weather, flow, and hence bacteria loads, are largely generated by non-storm water runoff, which is not a product of a reference system. Therefore, a zero percent allowable exceedance frequency is included in the numeric targets for the dry weather TMDL calculations.

I.3 Using Load Duration Curves to Calculate Wet Weather Mass-Load Based TMDLs

For the wet weather analysis, “existing” loads and TMDLs were calculated using output from the LSPC watershed model. The existing loads calculated by the LSPC model are the bacteria loads that are expected to be discharged from the watershed under a set of critical conditions (i.e., worst case loading scenario). The TMDLs calculated by the LSPC model are the bacteria loads that can be discharged from the watershed and will not cause the numeric targets (numeric WQOs and allowable exceedance frequency) to be exceeded under the same set of critical conditions. The difference between the existing load and the TMDL is the bacteria load reduction that is required to restore the REC-1 beneficial use of an impaired waterbody and still account for natural, and largely uncontrollable sources of bacteria (e.g., bird and wildlife feces) in the wet weather loads.

To ensure that the numeric targets are met in impaired waterbodies during wet weather events, a critical period associated with extreme wet conditions was selected for TMDL calculations. Extreme wet conditions have the highest wet weather flows and bacteria loads. The year 1993 was selected as the critical wet period for assessment of extreme wet weather loading conditions because this year was the wettest year of the 12 years of record (1990 through 2002) evaluated in the TMDL analysis. This corresponds to the 92nd percentile of annual rainfalls for those 12 years measured at multiple rainfall gages in the San Diego Region.

Model output was used to produce load-duration curves, such as the one shown in Figure I-1. Load-duration curves are bar graphs that display information for a specific watershed mouth (watersheds were delineated into smaller subwatersheds for loading analysis). In other words, each subwatershed has a unique load-duration curve. The y-axis shows the bacteria load (billion most-probable-number per day, or billion MPN/day) associated with the flow for a given day. Each daily wet weather load is represented by a bar. The bars are ranked across the x-axis according to the magnitude of the associated daily flow from lowest to highest. Appendix O shows the load-duration curves for each modeled subwatershed, for each type of bacteria. Figure I-1 shows model-calculated fecal coliform loads for one of the subwatersheds (identified as subwatershed number 202) in the Aliso HSA watershed (which consists of subwatersheds 201 and 202).

The daily bacteria load (each blue bar) is equal to the modeled average daily flow for the wet day times the average daily bacteria density for that day. The height of the blue bars indicates the most probable number of fecal coliform colonies corresponding to the flow on a given day. The dark line running across the bar graph is referred to as the “load capacity curve” or “numeric target line.”

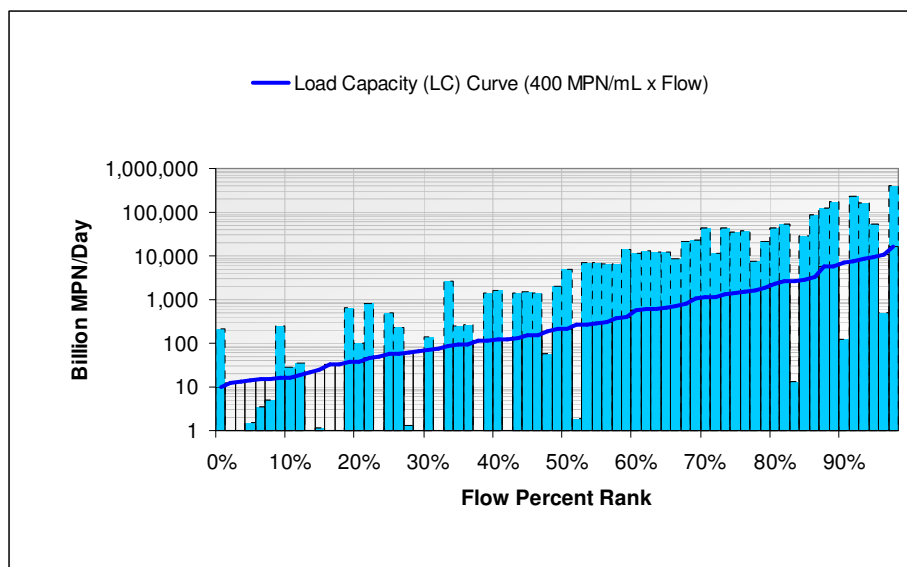


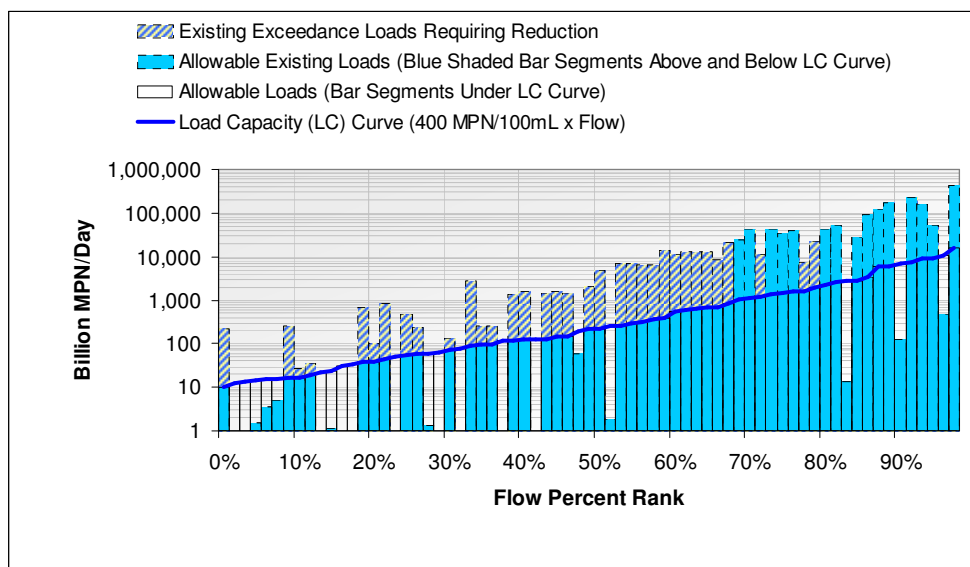
Figure I-1. Load Duration Curve for Aliso HSA Subwatershed # 202

The y-value of the numeric target line at any point on the graph represents the total maximum bacteria load that would not result in an exceedance of the WQO for the flow on that day. The summation of the loads represented by the solid-line outlined bar segments below the numeric target line represents the loading capacity of the waterbody on an annual basis that will not cause numeric WQO to be exceeded. The dashed-line outlined bar segments above the numeric target line represent the bacteria load that is exceeding the load capacity based on the WQO on each wet day. For some wet days, the existing bacteria load (blue bar) is below the numeric target line, indicating the load on that day would not cause an exceedance in the WQO.

Load-duration curves are useful for quantifying the total load for existing conditions (during the critical period), and the allowable loads (TMDLs) that must not be exceeded in order to attain WQOs and restore the REC-1 beneficial use of an impaired waterbody. Section I.4 shows how load-duration curves were used to calculate TMDLs using numeric targets (numeric WQOs and allowable exceedance frequencies). In the wet weather analyses, existing loads and TMDLs are expressed on a yearly basis (billion MPN/year) because of the extremely high daily variability in storm flow magnitude and loading in the watersheds addressed by these TMDLs. The variability in the modeled daily loads is evident in the load duration curves in Appendix O.

I.4 Calculation of Wet Weather Mass-Load Based TMDLs and Allocations

As mentioned previously, wet weather TMDLs for recreational uses incorporated the reference system approach. Since storm flow loading in reference watersheds causes exceedances of single sample maximum WQOs, TMDLs for urban watersheds should allow the single sample WQOs to be exceeded at the same frequency as in a similar reference system. Load duration curves were used to calculate allowable exceedance loads from allowable exceedance days for wet weather TMDLs. A load-duration curve showing the application of the reference system approach is shown in Figure I-2.



Subwatershed 202 Fecal Coliform Loading Summary		Value	Units
Total Wet Days During Critical Wet Year		69	Days
Total Wet Exceedance Days (Number of Bars with Segment Above LC Curve)		49	Days
Allowable Wet Weather Exceedance Frequency		22	Percentage
Allowable Wet Exceedance Days (Total Wet Days x Exceedance Frequency)		15	Days
Non-Allowable Wet Exceedance Days Requiring Load Reduction		34	Days
Total Existing Load for Existing Condition (Sum of All Shaded Bar Segments)		1,732,709	Billion MPN/Year
Allowable Load (Sum of Solid Outline Bar Segments Under LC Curve)		83,999	Billion MPN/Year
Allowable Exceedance Load (Sum of Blue Shaded Bar Segments Above LC Curve)		1,478,595	Billion MPN/Year
Total Allowable Load [TMDL] (Sum of Allowable Load and Allowable Exceedance Load)		1,562,594	Billion MPN/Year
Exceedance Load Requiring Reduction (Total Existing Load - Total Allowable Load)		170,116	Billion MPN/Year

*Figure I-2. Load Duration Curve for Aliso HSA Subwatershed #202
Using Reference System Approach*

The methodology for calculating and allocating the wet weather TMDLs for each watershed using the reference system approach is described in the following steps:

- Step 1. Quantify Total Existing Wet Weather Loads;
- Step 2. Quantify Allowable Loads;
- Step 3. Quantify Allowable Exceedance Loads;
- Step 4. Quantify Wet Weather TMDLs;
- Step 5. Classify Land Use Types as Point and Nonpoint Sources, and Classify Nonpoint Sources as Controllable or Uncontrollable;
- Step 6. Quantify Relative Contribution of Bacteria Loads From Each Land Use Type;
- Step 7. Separate Caltrans Existing Loads from Loads Generated by Industrial/Transportation Land Use;
- Step 8. Combine Land Use Types Based on Method of Regulation by the San Diego Water Board;
- Step 9. Distribute TMDL Among Four Discharge/Land Use Categories.

Steps 1 through 4 use the information provided by load-duration curves. Steps 5 through 9 are determined based on land use data. Descriptions of each step are provide below. Sample calculations are provided showing all the steps involved.

1. Quantify Total Existing Wet Weather Loads

As discussed in section I.3, the output from the LSPC model was used to predict bacteria loading from each watershed for the critical wet period in 1993. Model-predicted loads were used to construct load-duration curves for each of the three indicator bacteria. Figure I-1, above, is a sample load-duration curve that shows model-calculated fecal coliform loads for subwatershed 202 in the Aliso HSA watershed.

The load-duration curves are bar graphs that rank the modeled flows into percentiles, or groups arranged in increasing orders of magnitude. The height of the blue bars indicates the number of bacteria colonies corresponding to the flow volume on a given day. The summation of all the blue bar segments represents the total existing annual bacteria load for wet weather in the critical wet period of 1993.

2. Quantify Allowable Loads

The dark line running across the bar graph (referred to as the “numeric target line” or “load capacity curve”) in Figures I-1 and I-2 represents the total maximum bacteria load that would not result in an exceedance of the numeric WQO for the flow volume on that day. In the case for Figures I-1 and I-2, the wet weather numeric WQO is the single sample maximum REC-1 WQO for fecal coliform, which is 400 MPN/100mL (see section 4 of the Technical Report). The load capacity curve is calculated by multiplying the numeric WQO by the total flow volume for each day. So, if the daily flow volume increases, the target daily load will increase; but the numeric target stays constant.

The solid-line outlined bar segments below the numeric target line represent the loading capacity of the waterbody that will not cause the numeric WQO (i.e., REC-1 WQO) to be exceeded for each day. The summation of the solid-line outlined bar segments below the numeric target line is total allowable annual bacteria load for wet weather in the critical wet period of 1993, based only on the numeric WQOs.

3. Quantify Allowable Exceedance Loads

Because natural, and largely uncontrollable sources of bacteria (e.g., bird and wildlife feces) in the wet weather loads generated in the watersheds and at the beaches can, by themselves, cause exceedances of WQOs, allowable exceedance loads were calculated and incorporated into the wet weather TMDLs. A Basin Plan amendment (Resolution No. R9-2008-0028) was adopted by the San Diego Water Board authorizing the development of indicator bacteria TMDLs that account for exceedances of bacteria WQOs due to bacteria loads from natural uncontrollable sources.²

² Resolution No. R9-2008-0028, *Implementation Provisions for Indicator Bacteria Water Quality Objectives to Account for Loading from Natural Uncontrollable Sources Within the Context of a TMDL*, adopted by the San Diego Water Board on May 14, 2008, approved by the State Water Board on March 17, 2009, approved by OAL on June 25, 2009, and approved by USEPA on September 16, 2009.

The first step was to identify an appropriate allowable exceedance frequency. The allowable exceedance frequency is determined by identifying an appropriate reference system. A reference system is a beach and upstream watershed that are minimally impacted by anthropogenic activities, typically having at least 95 percent open space.. To be consistent with the Los Angeles Water Board, in the calculation of the wet weather TMDLs the San Diego Water Board chose to apply the 22 percent allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County.³

The next step is to quantify the allowable exceedance load associated with a 22 percent exceedance frequency. The allowable exceedance frequency was converted into allowable exceedance days. The number of allowable exceedance days for each subwatershed was calculated as follows. For each watershed, the number of wet days in 1993 was documented. Wet days are defined as days with 0.2 inches or more of rainfall and the following 72 hours. For each watershed, the number of wet days in 1993 is presented Table I-1.

Table I-1. Wet Days of the Critical Period (1993) Identified for Watersheds Affecting Impaired Waterbodies

Watershed	Number of Wet Days in 1993
San Joaquin Hills HSA/Laguna Beach HSA	69
Aliso HSA	69
Dana Point HSA	69
Lower San Juan HSA	76
San Clemente HA	73
San Luis Rey HU	90
San Marcos HA	49
San Dieguito HU	98
Miramar Reservoir HA	94
Scripps HA	57
Tecolote HA	57
Mission San Diego HSA/Santee HSA	86
Chollas HSA	65

The number of days that exceedances of numeric targets are allowed for each particular watershed is obtained by multiplying the number of wet days by the exceedance frequency. For example, the Aliso HSA watershed had 69 wet days in 1993. The allowable exceedance frequency of the wet weather numeric targets under the reference system approach is 22 percent. Therefore, the number of allowable exceedance days for the Aliso HSA watershed is:

$$69 \text{ Wet Days} * 0.22 = 15 \text{ Allowable Exceedance Days}$$

The number of allow exceedance days for each watershed is presented Table I-2.

³ The Los Angeles Water Board used the Arroyo Sequit Watershed as the reference system watershed for development of TMDLs for the Santa Monica Bay beaches and Malibu Creek (Los Angeles Water Board, 2002 and 2003). This watershed, consisting primarily of unimpacted land use (98 percent open space), discharges to Leo Carillo Beach, where 22 percent of wet weather fecal coliform data (10 out of 46 samples) were observed to exceed the WQOs).

*Table I-2. Allowable Exceedance Days for Watersheds
Affecting Impaired Waterbodies*

Watershed	Number of Allowable Exceedance Days
San Joaquin Hills HSA/Laguna Beach HSA	15
Aliso HSA	15
Dana Point HSA	15
Lower San Juan HSA	17
San Clemente HA	16
San Luis Rey HU	20
San Marcos HA	11
San Dieguito HU	22
Miramar Reservoir HA	21
Scripps HA	13
Tecolote HA	13
Mission San Diego HSA/Santee HSA	19
Chollas HSA	14

The days with the highest loads were chosen as the allowable exceedance days because the highest loads in most of the watersheds correspond to open space land uses where bacteria loads are generated from natural sources. The solid blue bar segments above the numeric target line shown on the example load-duration curve in Figure I-2 correspond to the 22 percent exceedance frequency allowed for loading from uncontrollable sources. The number of solid blue bar segments above the numeric target line is equal to the allowable exceedance days shown in Table I-2. For the Aliso HSA watershed, there are 15 allowable exceedance days, which correspond to the 15 solid blue bar segments above the numeric target line shown in Figure I-2.

The solid blue bar segments above the numeric target line represent the reference system loading capacity of the waterbody that will not cause the numeric targets to be exceeded on more than 22 percent of the wet days. The summation of the solid blue bar segments above the numeric target line is the total allowable annual bacteria exceedance load for wet weather in the critical wet period of 1993.

4. Quantify Wet Weather TMDLs

The solid-line outlined bar segments below the numeric target line plus the solid blue bar segments above the numeric target line are equal to the total allowable bacteria loads, or total maximum annual wet weather bacteria loads, for the subwatershed. In other words, the sum of the allowable loads calculated under step 2 and the allowable exceedance loads calculated under step 3 is equal to the TMDL for the subwatershed.

The existing loads and TMDLs for each watershed are calculated by summing the existing loads and TMDLs of all the modeled subwatersheds in each watershed. For example, the total existing bacteria load from the Aliso HSA watershed is comprised of loads from subwatershed numbers 201 and 202 (these two subwatersheds are adjacent to the Pacific Ocean and are cumulative of the upstream watersheds). Numerical values were obtained from the charts associated with the load-duration curves for the Aliso HSA watershed, specifically Tables O-16 and O-19 (Appendix O) for this example. The “Total Existing Load For Existing Condition” (Existing Load) for the

Aliso HSA watershed is the sum of the “Total Existing Load for Existing Conditions” for subwatersheds 201 and 202 from Tables O-16 and O-19, respectively. The “TMDL” for the Aliso HSA watershed is the sum of the “Total Allowable Load [TMDL]” (Allowable Load) for subwatersheds 201 and 202 from Tables O-16 and O-19, respectively. The Total Load and the TMDL for the Aliso HSA watershed are calculated in the following equations.

$$\begin{aligned}\text{Existing Load} &= (\text{Existing Load})_{\text{Subwatershed 201}} + (\text{Existing Load})_{\text{Subwatershed 202}} \\ &= 19,386 \text{ billion MPN/mL} + 1,732,709 \text{ billion MPN/mL} \\ &= 1,752,095 \text{ billion MPN/mL}\end{aligned}$$

$$\begin{aligned}\text{TMDL} &= (\text{Allowable Load})_{\text{Subwatershed 201}} + (\text{Allowable Load})_{\text{Subwatershed 202}} \\ &= 16,480 \text{ billion MPN/mL} + 1,562,594 \text{ billion MPN/mL} \\ &= 1,579,074 \text{ billion MPN/mL}\end{aligned}$$

The same calculations were performed for each watershed by summing the “Total Existing Load for Existing Condition” and “Total Allowable Load [TMDL],” respectively, of all the modeled subwatersheds in each watershed. Table I-3 shows the wet weather existing loads and TMDLs on an annual basis for all major watersheds included in this project for fecal coliform, total coliform, and enterococci bacteria, which were derived from the load-duration curves in Appendix O.

Table I-3. Wet Weather Existing Loads and TMDLs (Billion MPN/Year)

Watershed	Fecal Coliform		Total Coliform		Enterococci	
	Existing	TMDL	Existing	TMDL	Existing	TMDL
San Joaquin Hills HSA/Laguna Beach HSA	705,015	664,634	8,221,901	7,445,649	852,649	782,799
Aliso HSA	1,752,095	1,579,073	23,210,774	20,190,798	2,230,206	1,950,964
Dana Point HSA	403,911	377,313	6,546,962	6,031,472	501,526	462,306
Lower San Juan HSA	15,304,790	14,714,833	130,258,863	122,879,189	12,980,098	12,152,446
San Clemente HA	1,441,723	1,378,931	16,236,606	15,147,603	1,663,100	1,563,187
San Luis Rey HU	33,120,012	32,444,242	231,598,677	224,150,535	18,439,920	17,463,618
San Marcos HA	20,886	17,224	515,278	425,083	40,558	32,966
San Dieguito HU	21,286,910	21,101,649	163,541,133	159,814,184	14,796,210	14,307,087
Miramar Reservoir HA	10,392	10,256	212,986	210,180	11,564	11,405
Scripps HA	204,057	176,907	5,029,519	4,356,973	377,839	324,032
Tecolote HA	261,966	229,322	7,395,789	6,379,770	708,256	603,761
Mission San Diego HSA/Santee HSA	4,932,380	4,680,838	72,757,569	66,105,222	7,255,759	6,590,966
Chollas HSA	603,863	520,440	15,390,608	13,247,626	1,371,972	1,152,645

The difference between the existing load and TMDL is represented by the sum of the patterned bar segments above the numeric target line. The patterned bar segments above the numeric target line represent the bacteria loads that are in exceedance of the numeric target (i.e., REC-1 WQOs and allowable exceedance frequency) that must be reduced to meet the TMDL.

5. Classify Land Use Types as Point or Nonpoint Sources, and Classify Nonpoint Sources as Controllable or Uncontrollable

For purposes of TMDL allocation to sources, all land use types were classified based on whether or not they generated mainly point or nonpoint sources of bacteria. Nonpoint source land use

categories were further divided into controllable or uncontrollable sources. The classification of a land use as generating either point or nonpoint sources was based on the likelihood that the land use was urban and would occur in an area drained by municipal separate storm sewer systems (MS4s), or was rural and outside of MS4 drained areas. The rationale for identifying specific responsible dischargers is discussed in the Technical Report, sections 10 and 11.

Point sources are defined as “any discernable, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged” [CWA section 502(6)].

Land use types considered urban and generating mostly point source loads from storm drain discharges were identified as:

- Low Density Residential;
- High Density Residential;
- Commercial/Institutional;
- Industrial/Transportation (excluding areas owned by Caltrans);
- Caltrans;
- Military;
- Parks/Recreation; and
- Transitional (construction activities).

Bacteria loads from these land use types were classified as point sources because, although they may be diffuse in origin, these land uses are typically found in urbanized areas, and the pollutant loading is transported and discharged to receiving waters through MS4s. MS4s are considered point sources because they discharge waste out of a discrete pipe. The principal MS4s contributing bacteria to receiving waters are owned or operated by either municipalities located throughout the watersheds or the California Department of Transportation (Caltrans). Municipal and Caltrans MS4 discharges are regulated separately under different NPDES requirements. For this reason, in each watershed, loads generated by Caltrans were separated from loads generated by Municipal MS4s.

Land use types considered rural and outside of areas drained by MS4s were identified as:

- Agriculture;
- Dairy/Intensive Livestock;
- Horse Ranches;
- Open Recreation;
- Open Space; and
- Water.

Bacteria loads from these land use types were classified as nonpoint sources because bacteria-laden discharges from these land uses are diffuse in origin, and originate in areas without constructed (man-made) MS4s. Nonpoint sources were separated into controllable and uncontrollable categories. Controllable sources included those found in the following land-use types: Agriculture, Dairy/Intensive Livestock, and Horse Ranches. These were considered

controllable because the land uses are anthropogenic in nature, and load reductions can be reasonably expected with the implementation of suitable management measures. For implementation purposes, controllable nonpoint source discharges are recognized as originating from activities related to agriculture, livestock, and horse ranch facilities. For this reason, these types of discharges were given load allocations (LAs) and were required to reduce their bacteria loads if they constitute more than 5 percent of the total TMDL (see step 7 for methodology for calculating LAs).

Uncontrollable nonpoint sources include loads from Open Recreation, Open Space, and Water land uses. Loads from these areas were considered uncontrollable because they come from natural sources (e.g. bird and wildlife feces) rather than anthropogenic sources. LAs from these sources were developed, but there were no accompanying load reductions expected since these sources are natural, largely uncontrollable, and regulation is not warranted.

6. Quantify Relative Contribution of Bacteria Loads From Each Land Use Type

The sum of all the shaded bars in the load-duration curves provides an estimate of the total load expected in each watershed during the critical condition (rainfall conditions documented in the critical period in 1993). The watershed model results were used to calculate the percent contribution from each of the 13 land use types to the total existing load (see Appendix J for discussion). Pie charts, like Figure I-3 below, shows these percentages for each watershed. Loads from each land use type were calculated by multiplying the existing load for the watershed by the percentages in the pie charts. Pie charts for each watershed are presented in Figures I-5 through I-40.

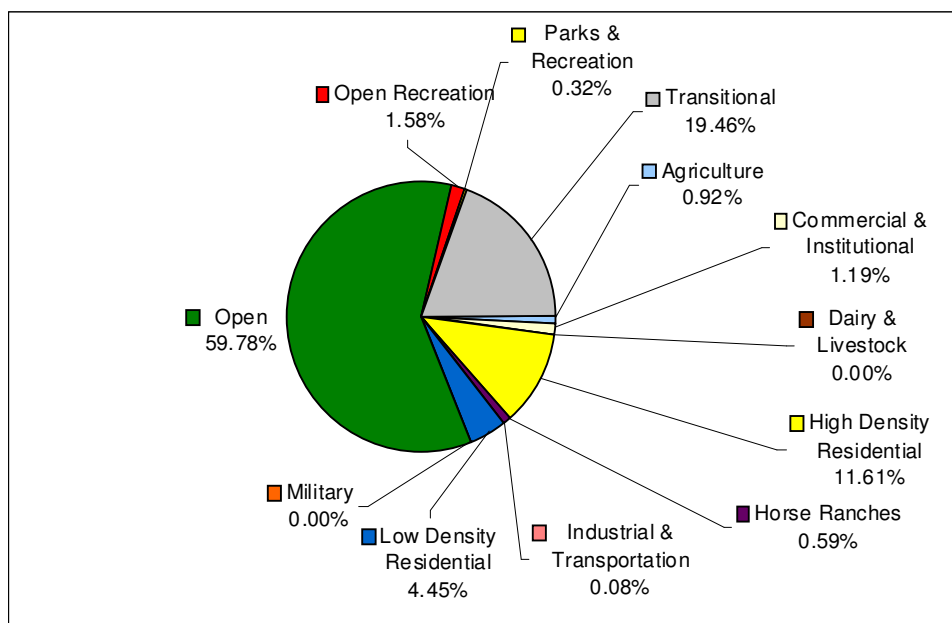


Figure I-3. Percent of Fecal Coliform Load Generated by Different Land Uses in the Aliso HSA Watershed

For example, the existing load from all sources to the Aliso HSA watershed is 1,752,095 billion MPN/year (Table O-16, O-19, Appendix O). The relative load from the High Density Residential land use can be calculated as follows:

$$\begin{aligned} \text{Existing Load from High Density Residential} &= 1,752,095 \text{ billion MPN/year} * 11.61\% \\ &= 203,418 \text{ billion MPN/year} \end{aligned}$$

Relative loads from all land use types, in all watersheds and each indicator bacteria are presented in Tables I-12 through I-14.

7. Separate Caltrans Existing Loads from Loads Generated by Industrial/Transportation Land Use

Highways owned by Caltrans are assumed to be part of the industrial and transportation land use category. Bacteria loads generated from Caltrans highways need to be quantified separately from the Industrial/Transportation land use, since ultimately discharges from Caltrans highways are regulated under their own set of waste discharge requirements (WDRs) implementing National Pollutant Discharge Elimination System (NPDES) regulations. Caltrans land use areas were not delineated in the geographic information system (GIS) data used in the wet weather modeling analysis. Thus, relative loads contributed by Caltrans could not be extracted directly from the watershed model results. To calculate an existing load from Caltrans, the area occupied by impermeable Caltrans owned highway surfaces was expressed as a percent of the total area occupied by the Industrial/Transportation land use, for each watershed. The area occupied by Caltrans in each of the impaired watersheds was provided by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005) as shown in Table I-4.

Using this information, the existing loads associated with the Industrial/Transportation land use was divided into two sources; one generated by the Municipal MS4s and one generated by Caltrans based on the percent of the total Industrial/Transportation land use area occupied by impermeable Caltrans' highways.

Table I-4. Caltrans Occupied Areas in Each Watershed

Watershed	Caltrans Occupied Area (sq miles)
San Joaquin Hills HSA/Laguna Beach HSA	0.19
Aliso HSA	0.17
Dana Point HSA	0.06
Lower San Juan HSA	0.73
San Clemente HA	0.18
San Luis Rey HU	1.17
San Marcos HA	0.01
San Dieguito HU	0.78
Miramar Reservoir HA	0.74
Scripps HA	0.00
Tecolote HA	0.24
Mission San Diego HSA/Santee HSA	1.94
Chollas HSA	0.57

An example calculation for the Aliso HSA watershed is shown below.

Industrial/Transportation land use area = 0.89 sq miles (Table J-1 in Appendix J)

Caltrans occupied area = 0.17 sq miles (Table I-4)

The percent of the Industrial/Transportation land use area that is occupied by Caltrans is:

$$\frac{0.17 \text{ sq miles}}{0.89 \text{ sq miles}} = 0.191 = 19.1\%$$

The existing loads generated by Caltrans were obtained by multiplying the percent area occupied by Caltrans by the loads generated by the Industrial/Transportation land use (Table I-10):

$$\begin{aligned} \text{Existing Fecal Coliform Load Generated by Caltrans} &= (\text{Percent of land use occupied by Caltrans}) \\ &\quad * (\text{Existing Fecal Coliform Load Generated by the Industrial/Transportation land use}) \\ &= 0.191 * 1,402 \text{ billion MPN/year} \\ &= 268 \text{ billion MPN/year} \end{aligned}$$

For two watersheds, San Joaquin Hills HSA/Laguna Beach HSA, and Dana Point HSA, the Caltrans occupied area was reported as being larger than the area reported for the Industrial/Transportation land use. The Caltrans data are more current (2005) than the GIS land use data (2000), thus, the discrepancy is most likely due to new highway construction since 2000 by Caltrans in these watersheds. In these cases, the loads generated by the Industrial/Transportation land use were attributed solely by Caltrans.

The loads generated by Caltrans calculated from the above methodology in the remaining watersheds are shown in Tables I-15 through I-17.

8. Combine Land Use Types Based on Method of Regulation by the San Diego Water Board

After the existing loads were calculated from each land use type (sources) in steps 6 and 7, the land use types were then combined into one of four discharge/land use categories. These categories were based on the manner in which discharges associated with these land uses are regulated by the San Diego Water Board. The land uses were grouped into the following four discharge categories:

Municipal MS4s = Sum of existing loads generated from Low Density Residential, High Density Residential, Commercial/Institutional, Industrial/Transportation (excluding Caltrans), Military, Parks/Recreation, and Transitional land uses

Caltrans = Existing load calculated from step 7

Agriculture/Livestock Operations (Ag/Livestock)	=	Sum of existing loads from Agriculture, Dairy/Intensive Livestock, and Horse Ranches land uses
Undeveloped Land (Open Space)	=	Sum of existing loads from Open Recreation, Open Space, and Water land uses

Discharges from the various land use types were grouped into these four categories for implementation purposes. Section 11 of the Technical Report discusses implementation of the TMDLs.

9. Allocate TMDL to the Four Discharge/Land Use Categories

Once TMDLs were determined in step 4, they were allocated to the four discharge/land use categories described in step 8. Wasteload allocations (WLAs) were assigned to point source discharges and load allocations (LAs) were assigned to nonpoint source discharges. The wet weather TMDLs were distributed as follows:

$$TMDL = WLA(MunicipalMS4s) + WLA(Caltrans) + LA(Ag / Livestock) + LA(Open Space)$$

where $TMDL$ = Total Maximum Daily Load for entire watershed

$$WLA (Municipal MS4s) = \text{Point source wasteload allocation for owners/operators of Municipal MS4s}$$
$$WLA (Caltrans) = \text{Point source wasteload allocation for Caltrans}$$
$$LA (Ag/Livestock) = \text{Nonpoint source load allocation for owners/operators of agriculture, livestock, and horse ranch facilities land uses}$$
$$LA (Open Space) = \text{Nonpoint source load allocation for uncontrollable sources of bacteria for open space, open recreation, and water land uses}$$

Since loads from Open Space, Open Recreation, and Water land uses are uncontrollable, the LAs for this category cannot be lower than the existing loads. Therefore the LAs for this category are the same as the existing loads generated by uncontrollable sources, as calculated from step 6, and cannot be reduced (i.e., $Existing Load (Open Space) = LA (Open Space)$).

Similarly, for Caltrans, the WLAs are identical to the existing loads generated by Caltrans in each watershed. However, the reasoning for this determination is different than the reasoning described for loading from uncontrollable sources. Inspection of Figures I-5 through I-40 indicate that wet weather loading from the Industrial/Transportation land use is less than 1 percent of the total existing load in all watersheds. Furthermore, Caltrans occupies a portion of this land use (Tables I-15 through I-17). Since Caltrans is an insignificant bacteria source compared to other controllable sources, the San Diego Water Board shall not impose stricter regulation than what is already in place (see section 11 for a description of regulation of Caltrans with respect to these TMDLs). Therefore, no reductions are required for Caltrans. (i.e., $Existing Load (Caltrans) = WLA (Caltrans)$) The remaining portion of the TMDL is distributed between the Municipal MS4s and Ag/Livestock categories, as follows:

$$TMDL - WLA(Caltrans) - LA(Open Space) = WLA(MunicipalMS4s) + LA(Ag / Livestock)$$

The methodology used for distributing the remaining portions of the TMDL between the Municipal MS4s and the Ag/Livestock categories depended on whether or not the relative bacteria loads contributed by agriculture, livestock, and horse ranch facilities (i.e., *Existing Load (Ag/Livestock)*) were significant compared to loads from urbanized areas. Although allocations are distributed to the identified dischargers of bacteria, this does not imply that other potential sources do not exist. Any potential sources in the watersheds, such as publicly owned treatment works, not receiving an explicit allocation as described above is allowed a zero discharge of bacteria to the impaired beaches and creeks.

a) Methodology When Ag/Livestock Sources are an Insignificant Portion of the Total Existing Load

Figures I-5 through I-40 demonstrate that in the San Joaquin Hills HSA/Laguna Beach HSA, Aliso HSA, Dana Point HSA, San Clemente HA, Miramar Reservoir HA, Scripps HA, Mission San Diego HSA/Santee HSA, and Chollas HSA watersheds, the proportion of the total existing load for all 3 indicator bacteria due to agriculture, livestock, and horse ranch facilities (loads associated with Agriculture, Dairy/Intensive Livestock, and Horse Ranches land uses) is less than 5 percent. For these watersheds, the LAs for agriculture, livestock, and horse ranch facilities are identical to existing loads calculated from these land uses. As with Caltrans and Open Space, LAs are given to agriculture, livestock, and horse ranch facilities; however no load reductions are required since these sources are insignificant compared to existing loads generated by urban sources in these watersheds (ie., *Existing Load (Ag/Livestock) = LA (Ag/Livestock)*). Therefore Municipal MS4s alone are required to reduce bacteria loads during wet weather events in these watersheds to meet the TMDLs.

WLAs for municipal MS4s are given by:

$$WLA(Municipal\ MS4s) = TMDL - WLA(Caltrans) - LA(Ag / Livestock) - LA(Open\ Space)$$

In the above equation, WLAs for Caltrans, LAs for agriculture, livestock, and horse ranch facilities, and LAs for uncontrollable sources are equal to existing loads from these sources as determined in steps 6 and 7. Using the Aliso HSA watershed as an example, the WLA for Municipal MS4s can be calculated using Table I-12. The WLA for fecal coliform for Municipal MS4s is

$$\begin{aligned} WLA(Municipal\ MS4s) &= [1,579,073 - 260 - 26,508 - 1,075,237] \text{ billion MPN/year} \\ &= 477,069 \text{ billion MPN/year} \end{aligned}$$

The percent reduction required for fecal coliform for the Municipal MS4s in the Aliso HSA watershed is

$$\begin{aligned}
 \text{Percent Reduction} &= \frac{(\text{Existing Load From Municipal MS4s} - \text{WLA (Municipal MS4s)})}{\text{Existing Load From Municipal MS4s}} \\
 &= \frac{(650,092 \text{ billion MPN / year} - 477,069 \text{ billion MPN / year})}{650,092 \text{ billion MPN / year}} \\
 &= 0.2662 \\
 &= 26.62\%
 \end{aligned}$$

b) Methodology When Ag/Livestock Sources are a Significant Portion of the Total Existing Load

In the Lower San Juan HSA, San Luis Rey HU, San Marcos HA, and San Dieguito HU watersheds, the agriculture, livestock, and horse ranch facilities generate more than 5 percent of the total wet weather load for all three indicator bacteria. Table I-5 shows the percent contribution of bacteria from agriculture, livestock, and horse ranch facilities to the total existing load in each watershed. This information is derived from the pie charts (Figures I-5 through I-40).

Table I-5. Percent Contribution of Bacteria from Agriculture, Livestock, and Horse Ranch Facilities to the Total Existing Loads

Watershed	Percent of Existing Load		
	Fecal Coliform	Total Coliform	Enterococci
San Joaquin Hills HSA/Laguna Beach HSA	1.04%	0.62%	0.38%
Aliso HSA	1.51%	0.77%	0.50%
Dana Point HSA	0.00%	0.00%	0.00%
Lower San Juan HSA	21.40%	14.20%	8.87%
San Clemente HA	0.03%	0.01%	0.01%
San Luis Rey HU	62.46%	50.67%	37.32%
San Marcos HA	53.62%	23.76%	19.29%
San Dieguito HU	55.77%	42.53%	29.90%
Miramar Reservoir HA	0.00%	0.00%	0.00%
Scripps HA	0.00%	0.00%	0.00%
Tecolote HA	0.00%	0.00%	0.00%
Mission San Diego HSA/Santee HSA	8.41%	4.80%	2.94%
Chollas HSA	0.00%	0.00%	0.00%

Similarly, the percent contribution from urbanized (i.e., municipal MS4) sources for each watershed is shown in Table I-6.

Table I-6. Percent Contribution of Bacteria from Urbanized Municipal MS4 Sources to the Total Existing Loads

Watershed	Percent of Existing Load		
	Fecal Coliform	Total Coliform	Enterococci
San Joaquin Hills HSA/Laguna Beach HSA	11.00%	20.15%	15.98%
Aliso HSA	37.10%	51.46%	45.50%
Dana Point HSA	44.33%	59.87%	51.59%
Lower San Juan HSA	8.67%	15.29%	14.64%
San Clemente HA	17.72%	28.13%	23.79%
San Luis Rey HU	2.85%	6.58%	7.98%
San Marcos HA	38.76%	71.03%	73.44%
San Dieguito HU	3.81%	10.64%	12.92%
Miramar Reservoir HA	65.81%	81.81%	71.50%
Scripps HA	62.93%	81.92%	75.65%
Tecolote HA	60.87%	83.19%	81.29%
Mission San Diego HSA/Santee HSA	9.58%	23.97%	21.44%
Chollas HSA	55.63%	78.12%	74.51%

Owners and operators of agriculture, livestock, and horse ranch facilities in the Lower San Juan HSA, San Luis Rey HU, San Marcos HA, and San Dieguito HU watersheds are given required reductions that are proportional to the existing loads generated by these sources. The LAs for the Ag/Livestock category are calculated as follows:

$$LA(\text{Ag / Livestock}) = [TMDL - WLA(\text{Caltrans}) - LA(\text{Open Space})] * \left[\frac{X}{Y} \right]$$

where X = % Total Existing Load from Agriculture/Livestock/Horse land uses
(Table I-3),

and

Y = % Total Existing Load from Agriculture/Livestock/Horse land uses
+ % Total Existing Load from Urban land uses (summation of entries from
Table I-5 and I-6)

In other words, the wasteload allocations for Caltrans and Open Space, which are equal to the existing loads for these categories and do not require reductions, are subtracted from the TMDL load. That difference ($[TMDL - WLA(\text{Caltrans}) - LA(\text{Open Space})]$) must be divided between the Ag/Livestock category and Municipal MS4 category. The ratio of the existing Ag/Livestock loading to the existing Municipal MS4 loading (the $[X/Y]$ term in the equation) is the basis for splitting the difference between the two categories.

The variables X and Y are determined from Tables I-3 and I-4, which are in turn derived from the pie charts (Figures I-5 through I-40).

An example calculation for Lower San Juan HSA watershed is shown below. The value for the TMDL is found in Table I-3. The values for the WLA (Caltrans), LA (Open Space) are equal to existing loads and are found in Table I-12. All values are specific to the Lower San Juan HSA watershed.

$$LA (Ag/Livestock) = [14,714,833 - 1,713 - 10,701,131] * \left[\frac{21.4\%}{21.4\% + 8.67\%} \right]$$

$$= 2,855,570 \text{ billion MPN/year}$$

The percent reduction required for fecal coliform for agriculture, livestock, and horse ranch facilities is

$$\text{Percent Reduction} = \frac{(\text{Existing Load From Ag/Livestock} - LA (Ag/Livestock))}{\text{Existing Load From Ag/Livestock}}$$

$$= \frac{(3,275,477 \text{ billion MPN / year} - 2,855,570 \text{ billion MPN / year})}{3,275,477 \text{ billion MPN / year}}$$

$$= 0.1282$$

$$= 12.82\%$$

Once WLAs for agriculture, livestock, and horse ranch facilities have been determined, the remaining portion of the TMDL is allocated to Municipal MS4s. The WLAs for Municipal MS4s are given by:

$$WLA(Municipal MS4s) = TMDL - WLA(Caltrans) - LA(Ag / Livestock) - LA(Open Space)$$

Using the value for *LA (Ag/Livestock)* calculated in the previous step, *WLA (Municipal MS4s)* can be determined for the Lower San Juan HSA watershed.

$$WLA (Municipal MS4s) = [14,714,833 - 1,713 - 10,701,131 - 2,855,477] \text{ billion MPN/year}$$

$$= 1,156,419 \text{ billion MPN/year}$$

Note that the formula for determining WLAs for Municipal MS4s is the same as the one described in methodology a). An important point is that the difference between the two methodologies is that in watersheds where loads from Ag/Livestock are insignificant, the LAs for this category are identical to existing loads. However, in watersheds where loads from Ag/Livestock are significant, the LAs for this category are lower than existing loads.

Table I-7 shows the WLAs, LAs, and percent reductions required for the Aliso HSA and Lower San Juan HSA watersheds using the methods outlined in this appendix. For the Lower San Juan HSA, San Luis Rey HU, San Marcos HA, and San Dieguito HU watershed, the Municipal MS4s and Ag/Livestock categories are required to reduce the bacteria loads in each watershed by the amount specified in Table I-18 through I-20.

Table I-7. WLAs and LAs (Billion MPN/Year) for Fecal Coliform in the Aliso Creek and San Juan Creek Watersheds

Watershed	TMDL	Point Sources				Nonpoint Sources				
		MS4		Caltrans*		Ag/Livestock			Open Space*	
		WLA	Reduction Required	WLA	Reduction Required	$\frac{X}{Y}$ **	LA	Reduction Required	LA	Reduction Required
Aliso HSA	1,579,073	477,069	26.62%	260	0.00%	0.04	26,508	0.00%	1,075,237	0.00%
Lower San Juan HSA	14,714,833	1,156,419	12.82%	1,713	0.00%	0.71	2,855,570	12.82%	10,701,131	0.00%

* No reductions are required for Caltrans or Open Space

** X = % Total Existing Load from Agriculture/Livestock/Horse land uses, and Y = % Total Existing Load from Agriculture/Livestock/Horse land uses + % Total Existing Load from Municipal MS4 land uses

The information in Table I-7 (except for the values for X and Y) is available for the remaining watersheds, and for total coliform and enterococci, and is reported in Tables I-18 through I-20, as well as Tables 9-2a, 9-2b, and 9-2c in section 9 of the Technical Report.

I.5 Calculation of Dry Weather TMDLs and Allocations

Because the density of bacteria in receiving waters during dry weather is extremely variable in nature, a separate approach from the wet weather LSPC model was needed. An approach was developed that relied on detailed analysis of available data to better identify and characterize sources.

To represent the linkage between source contributions and in-stream response, a steady-state mass balance model was developed to simulate transport of bacteria in the impaired creeks and the creeks flowing to impaired shorelines. This predictive model represents the streams as a series of plug-flow reactors, with each reactor having a constant, steady state flow and bacteria load. The development of the dry weather model is described in Appendix K.

The methodology for calculating and allocating the dry weather TMDLs for each watershed is described in the following steps:

- Step 1. Calculate Dry Weather Existing Loads and TMDLs;
- Step 2. Distribute TMDL Among Four Discharge/Land Use Categories.

Descriptions of each step are provide below.

1. Calculate Dry Weather Existing Loads and TMDLs

Unlike the wet weather modeling approach, the numeric targets used in the dry weather modeling approach have a zero percent allowable exceedance frequency. This is because available data show that exceedances of WQOs in local reference systems during dry weather conditions are uncommon (see Technical Report, section 4.2). Furthermore, reference systems do not generate significant dry weather bacteria loads because flows are minimal. During dry weather, flow, and hence bacteria loads, are largely generated by urban runoff, which is not a product of a reference system. Thus, the dry weather TMDL calculations are based entirely on meeting the geometric mean REC-1 WQOs.

A steady-state plug-flow reactor model was used to calculate dry weather existing loads and allowable loads. Total existing bacteria loads were calculated using the plug-flow reactor model predicted flow multiplied by the land-use-specific bacteria densities derived from regression analyses of bacteria water quality data from several regional watersheds. Allowable dry weather bacteria loads, or TMDLs, were calculated using the dry weather plug-flow reactor model predicted flow multiplied by the applicable numeric target, which is the geometric mean REC-1 WQO (see section 4 of the Technical Report). Table I-10 shows the dry weather existing loads and TMDLs calculated for all watersheds.

Table I-10. Dry Weather TMDLs (Billion MPN/Month)

Watershed	Fecal Coliform		Total Coliform		Enterococci	
	Existing	TMDL	Existing	TMDL	Existing	TMDL
San Joaquin Hills HSA/Laguna Beach HSA	2,741	227	13,791	1,134	2,321	41
Aliso HSA	5,470	242	26,639	1,208	4,614	40
Dana Point HSA	1,851	92	9,315	462	1,567	16
Lower San Juan HSA	6,455	1,665	30,846	8,342	5,433	275
San Clemente HA	3,327	192	16,743	958	2,817	33
San Luis Rey HU	1,737	1,058	8,549	5,289	1,466	185
San Marcos HA	149	26	751	129	126	5
San Dieguito HU	1,631	1,293	7,555	6,468	1,368	226
Miramar Reservoir HA	205	7	1,030	36	173	1
Scripps HA	3,320	119	16,707	594	2,811	21
Tecolote HA	4,329	234	21,349	1,171	3,657	39
Mission San Diego HSA/Santee HSA	4,928	1,506	28,988	7,529	4,106	248
Chollas HSA	5,068	398	25,080	1,991	4,283	66

2.

Unlike wet weather loading, which is caused by rain events, dry weather analysis showed that dry weather loading is dominated by nuisance flows from urban land use activities such as car washing, sidewalk washing, and lawn over-irrigation, which pick up and transport bacteria the the municipal MS4s into receiving waters. These types of nuisance flows are referred to as urban runoff. Urban runoff is non-storm water runoff.

Because urban runoff is overwhelmingly the main source of bacteria loading during dry weather, the TMDLs were allocated solely to Municipal MS4s. Allocations for nonpoint sources were unnecessary since land uses associated with these sources generally do not generate runoff to receiving water during dry weather conditions. Additionally, dry weather loads from Caltrans highways were assumed to be insignificant because during dry periods there is no significant urban runoff from Caltrans owned roadway surfaces. Because nonpoint sources and Caltrans are not expected to generate runoff during dry weather conditions, the dry weather TMDLs were distributed as follows:

$$TMDL = WLA(Municipal MS4s) + WLA(Caltrans) + LA(Ag / Livestock) + LA(Open Space)$$

where $TMDL$ = Total Maximum Daily Load for entire watershed

$WLA (Municipal MS4s)$ = Point source wasteload allocation for owners/operators of Municipal MS4s

$WLA (Caltrans)$ = 0 = No point source wasteload allocation for Caltrans because no runoff expected

$LA (Ag/Livestock)$ = 0 = No nonpoint source load allocation for owners/operators of agriculture, livestock, and horse ranch facilities/land uses because no runoff expected

$LA (Open Space)$ = 0 = No nonpoint source load allocation for uncontrollable sources of bacteria for open space, open recreation, and water land uses because no runoff expected

In other words, dry weather discharges from any sources other than Municipal MS4s is not expected or allowed. Therefore, the dry weather TMDL is as follows:

$$TMDL = WLA(Municipal MS4s)$$

Dry weather TMDLs are expressed on a monthly basis (MPN/month) because the numeric targets are equal to the 30-day geometric mean WQOs, and the dry weather model simulates average flows. An example showing the total coliform TMDL allocation is shown using the Aliso Creek watershed as an example. For the Aliso Creek watershed, the existing total coliform load estimated by the model was approximately 26,639 billion MPN/month. The percent reduction required and the allocations are shown in Tables I-11.

Table I-11. Dry Weather Final WLAs and LAs (Billion MPN/Month) for Total Coliform in the Aliso Creek Watershed

Watershed	TMDL	Point Sources				Nonpoint Sources			
		MS4		Caltrans		Ag/Livestock		Open Space	
		WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
Aliso HSA	1,208	1,208	95.9%	0	0.00%	0	0.00%	0	0.00%

Similar information for the remaining watersheds is reported in Tables 9-4a, 9-4b and 9-4c in section 9 of the Technical Report.

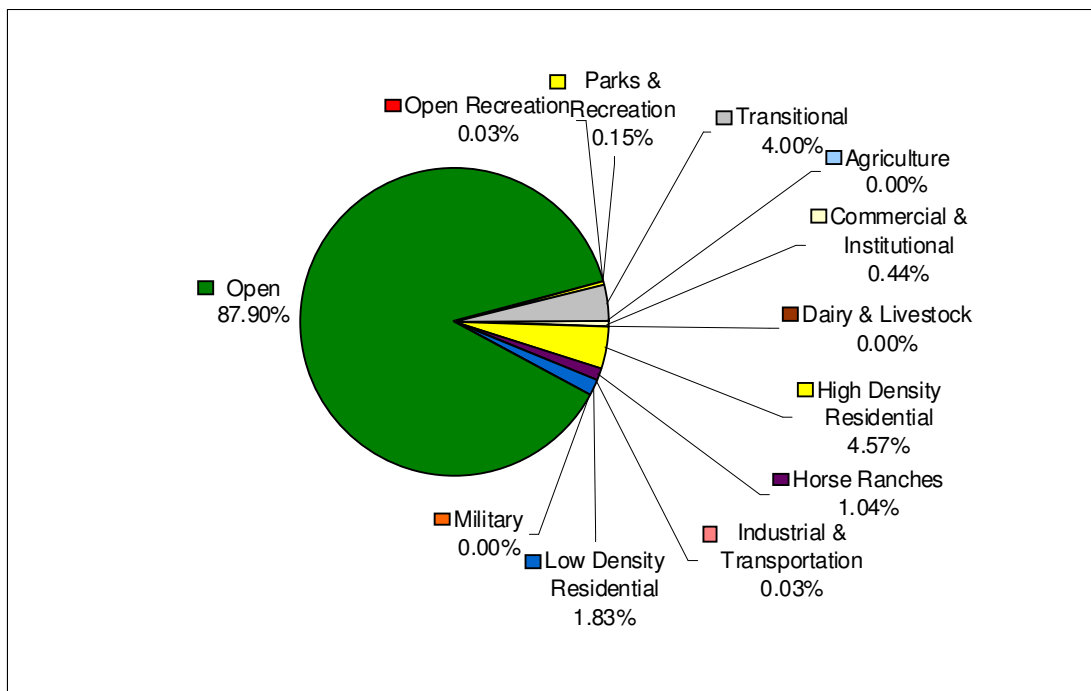


Figure I-5. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Joaquin Hills HSA/Laguna Beach HSA Watershed

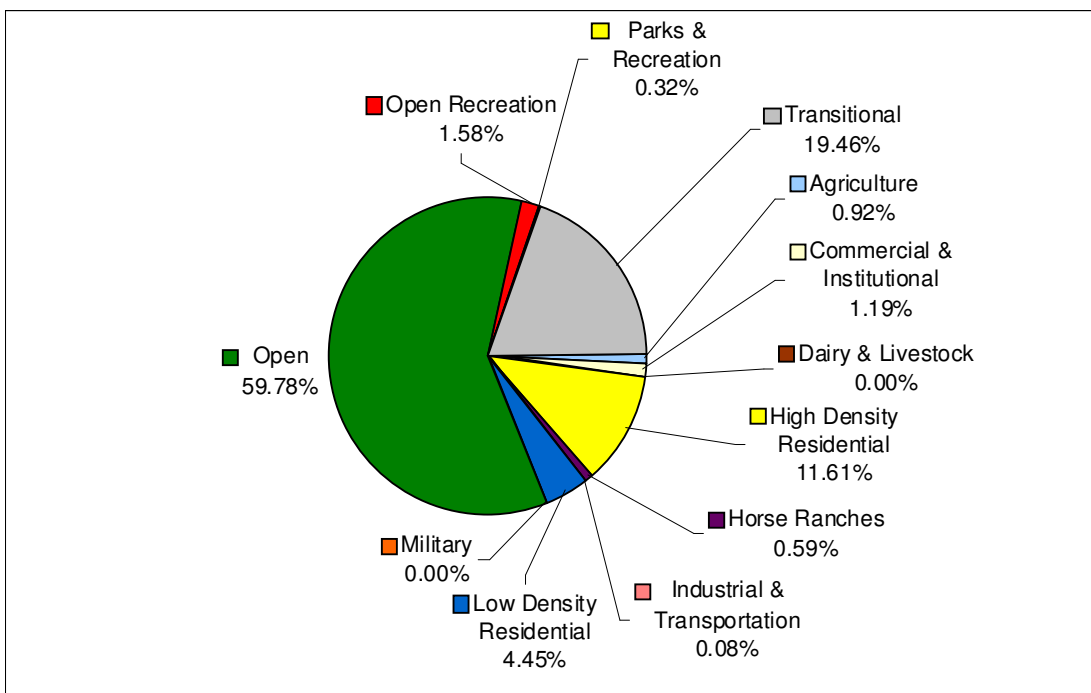


Figure I-6. Percent of Fecal Coliform Load Generated by Different Land Uses in the Aliso HSA Watershed

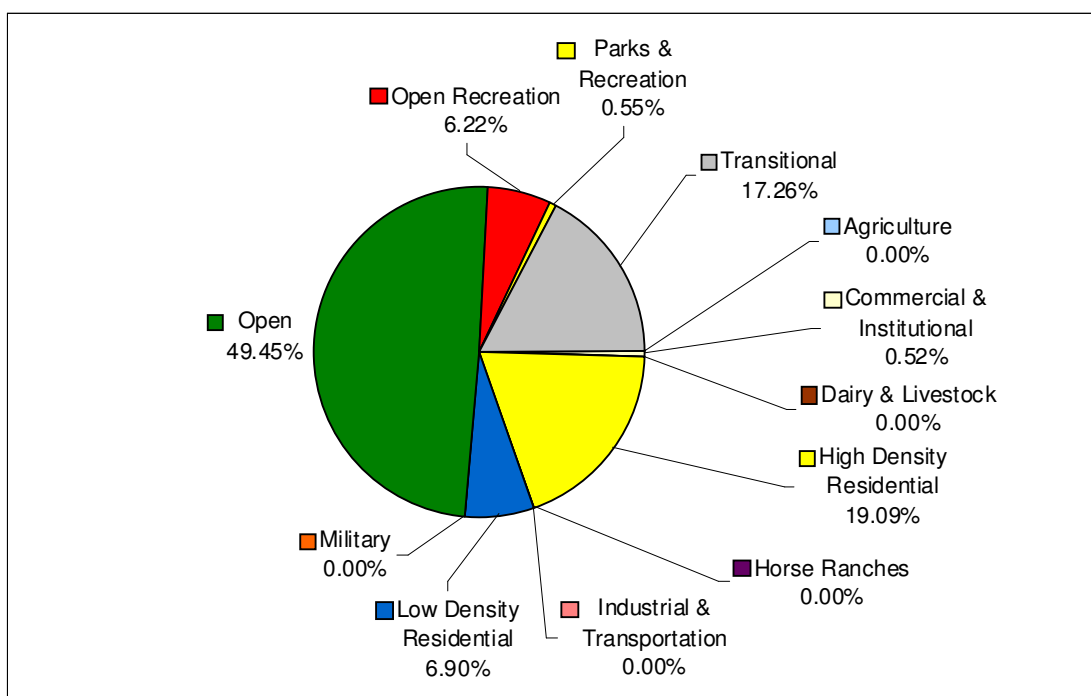


Figure I-7. Percent of Fecal Coliform Load Generated by Different Land Uses in the Dana Point HSA Watershed

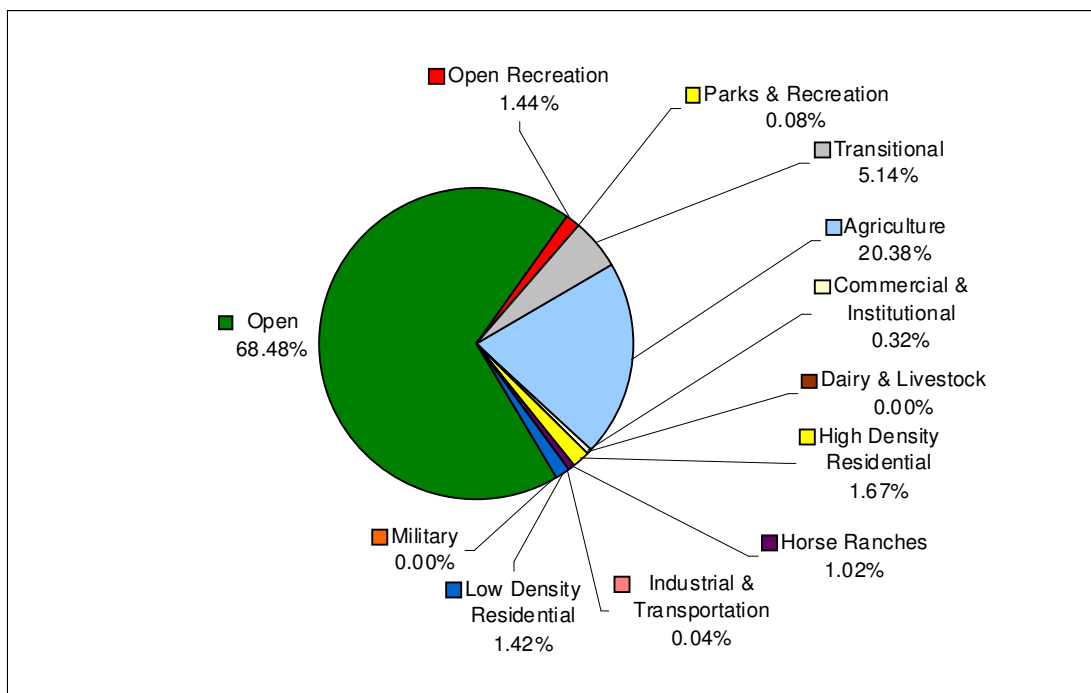


Figure I-8. Percent of Fecal Coliform Load Generated by Different Land Uses in the Lower San Juan HSA Watershed

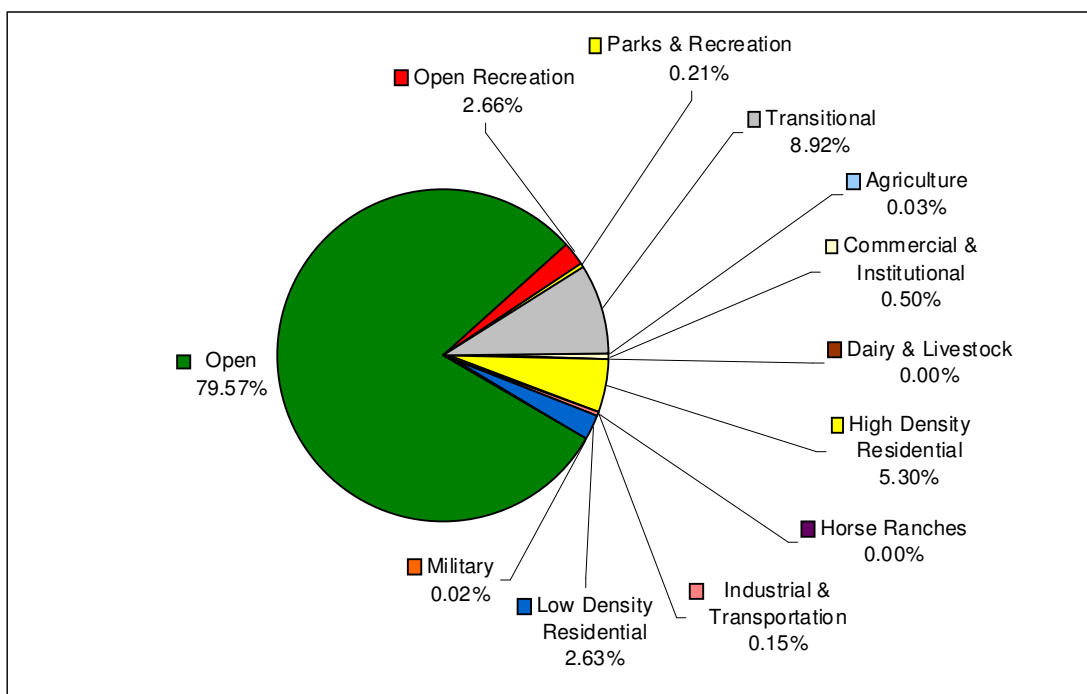


Figure I-

9. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Clemente HA Watershed

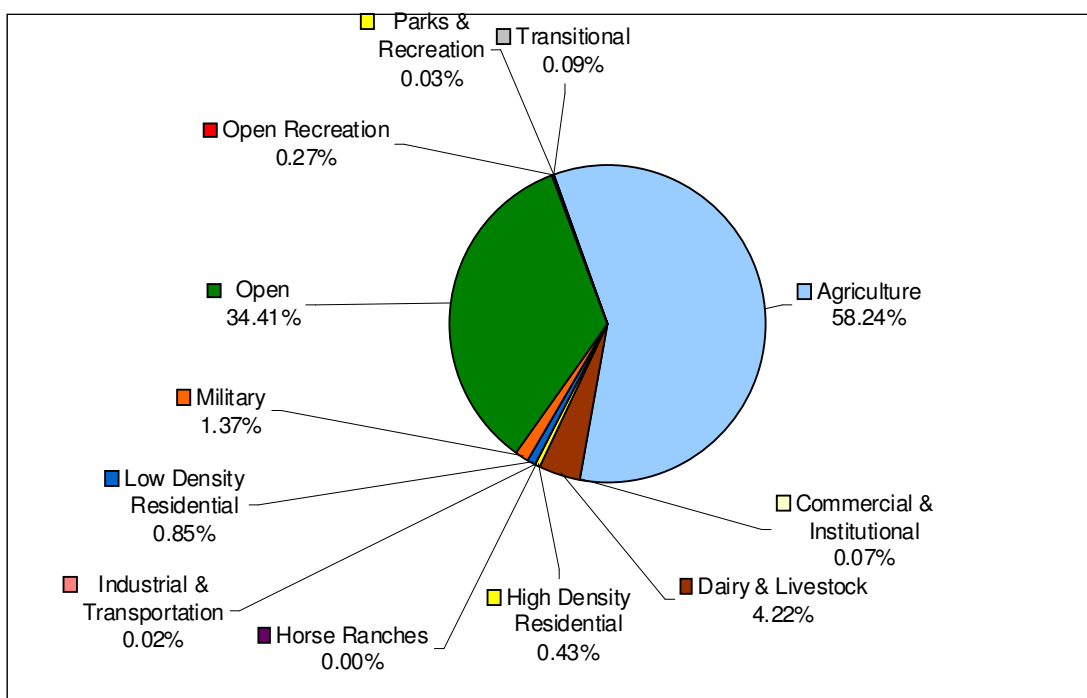


Figure I-

10. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Luis Rey HU Watershed

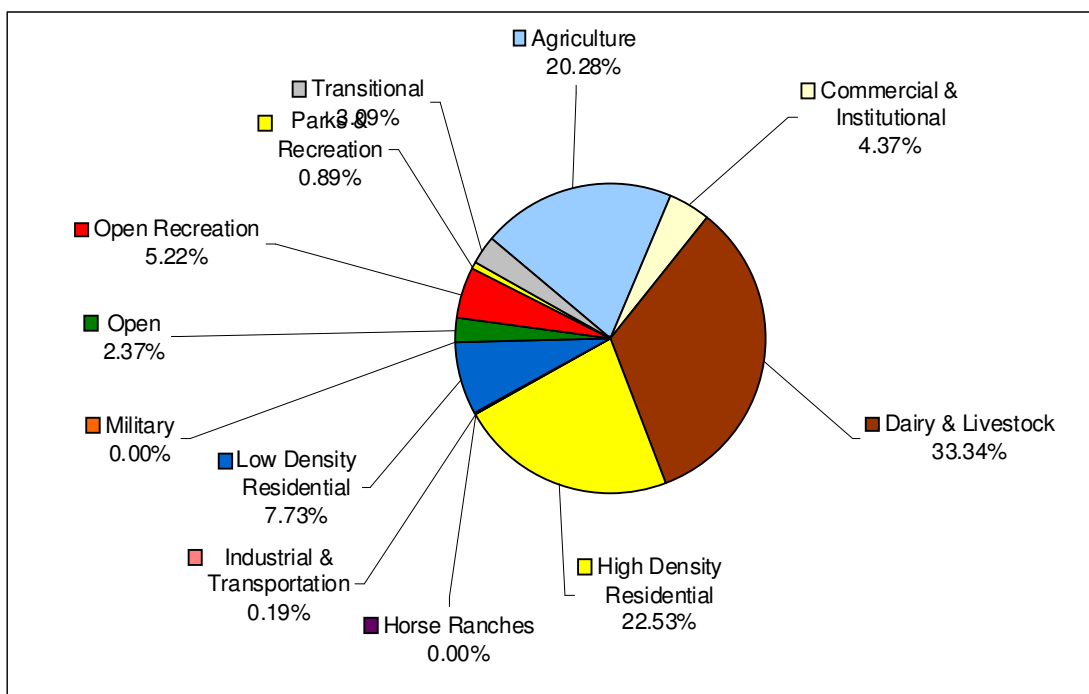


Figure I-

11. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Marcos HA Watershed

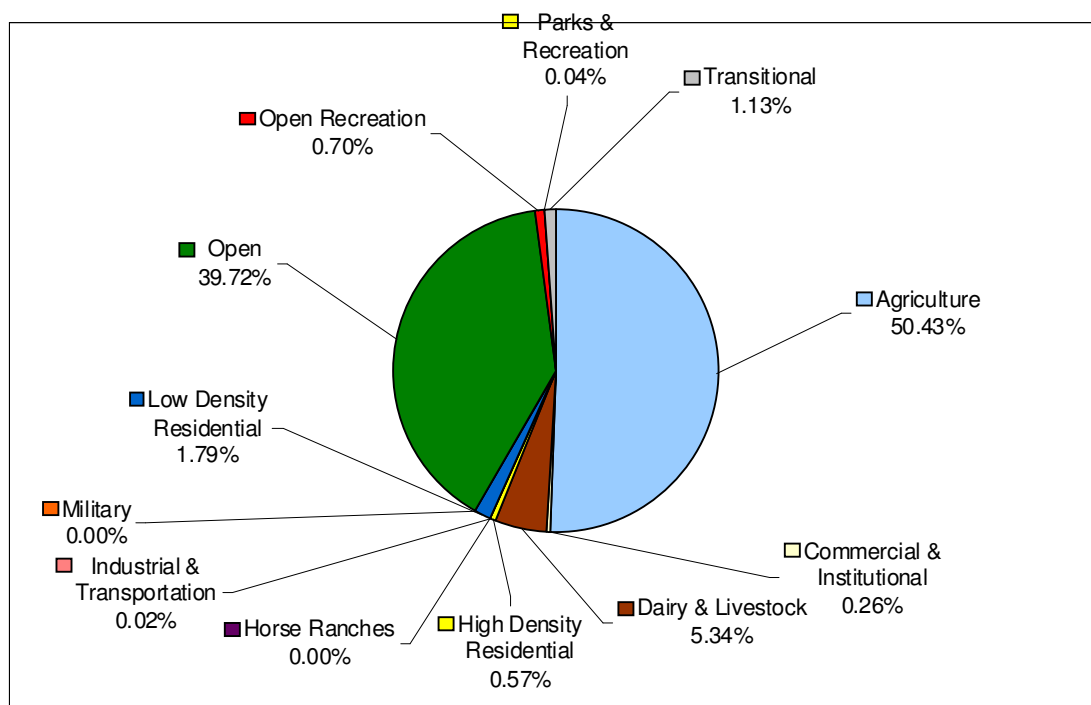


Figure I-12. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Diegoito HU Watershed

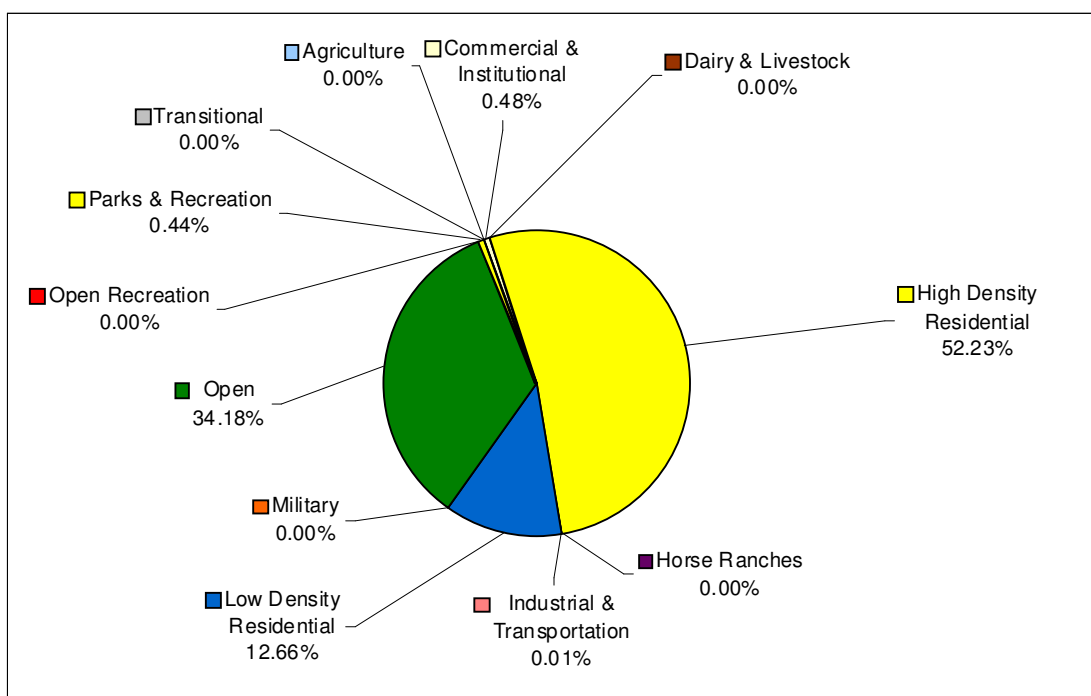


Figure I-13. Percent of Fecal Coliform Load Generated by Different Land Uses in the Miramar Reservoir HA Watershed

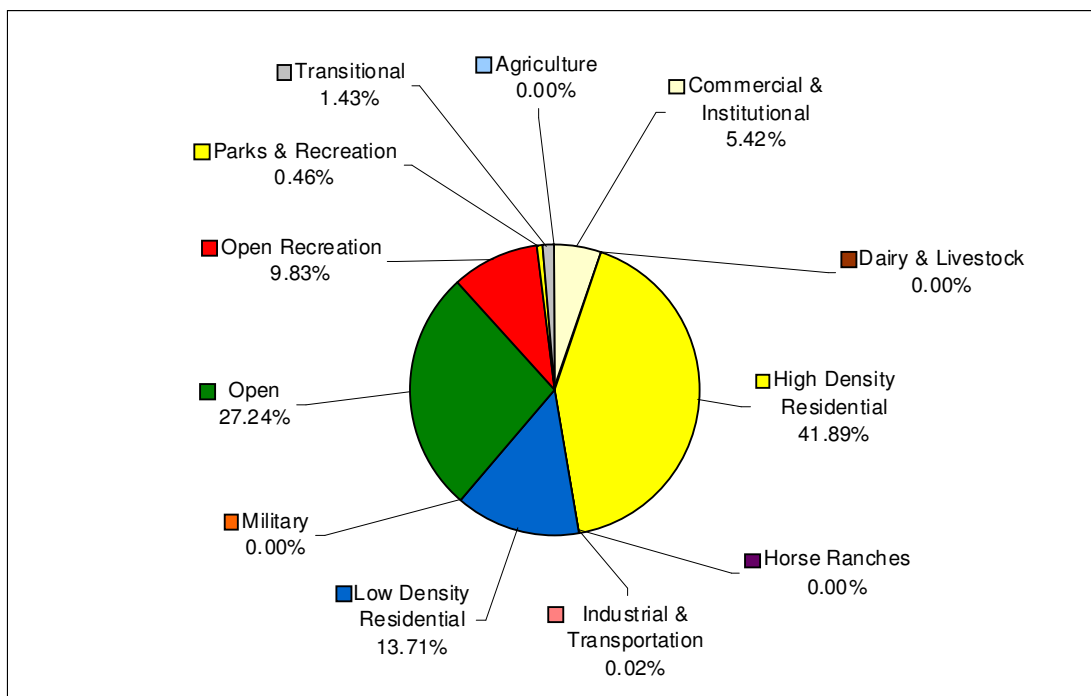


Figure I-14. Percent of Fecal Coliform Load Generated by Different Land Uses in the Scripps HA Watershed

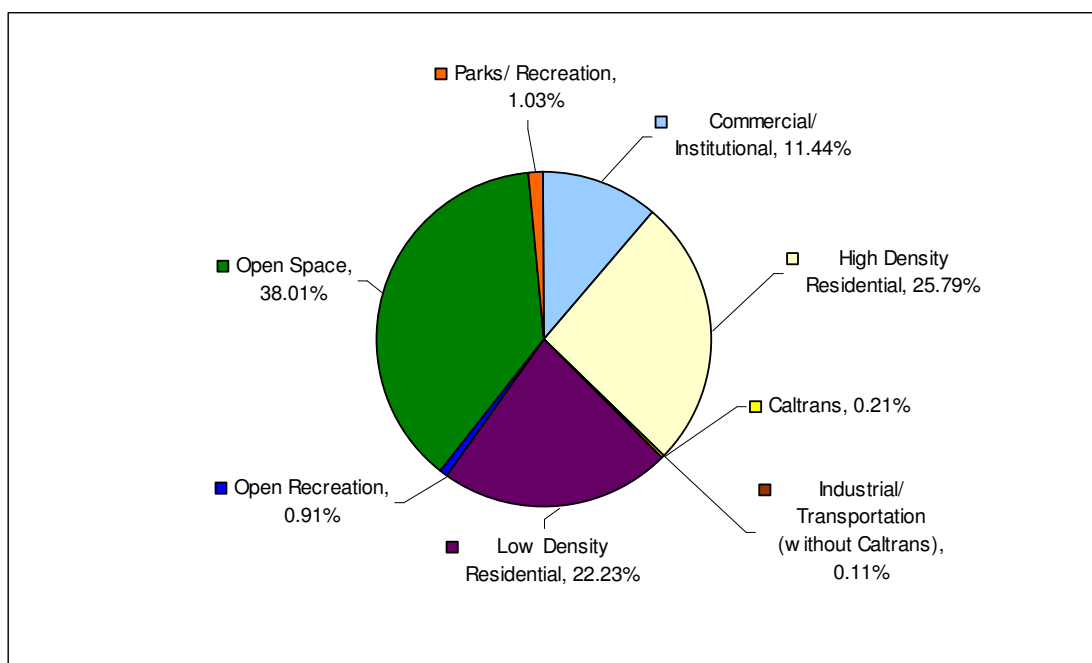


Figure I-15. Percent of Fecal Coliform Load Generated by Different Land Uses in the Tecolote HA Watershed

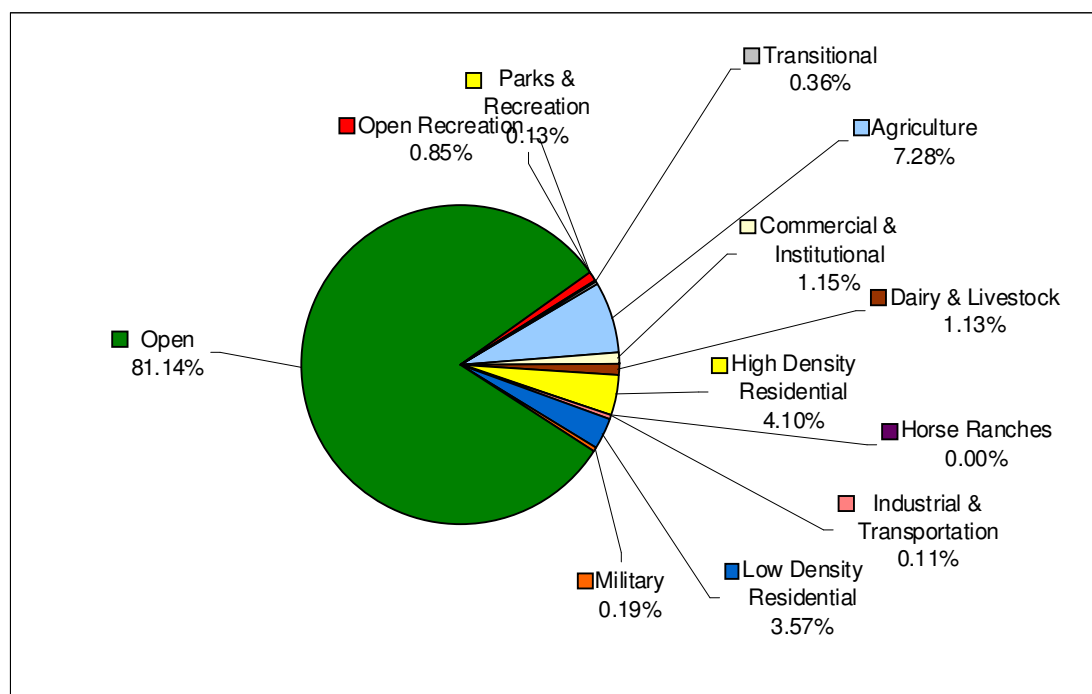


Figure I-16. Percent of Fecal Coliform Load Generated by Different Land Uses in the Mission San Diego HSA/Santee HSA Watershed

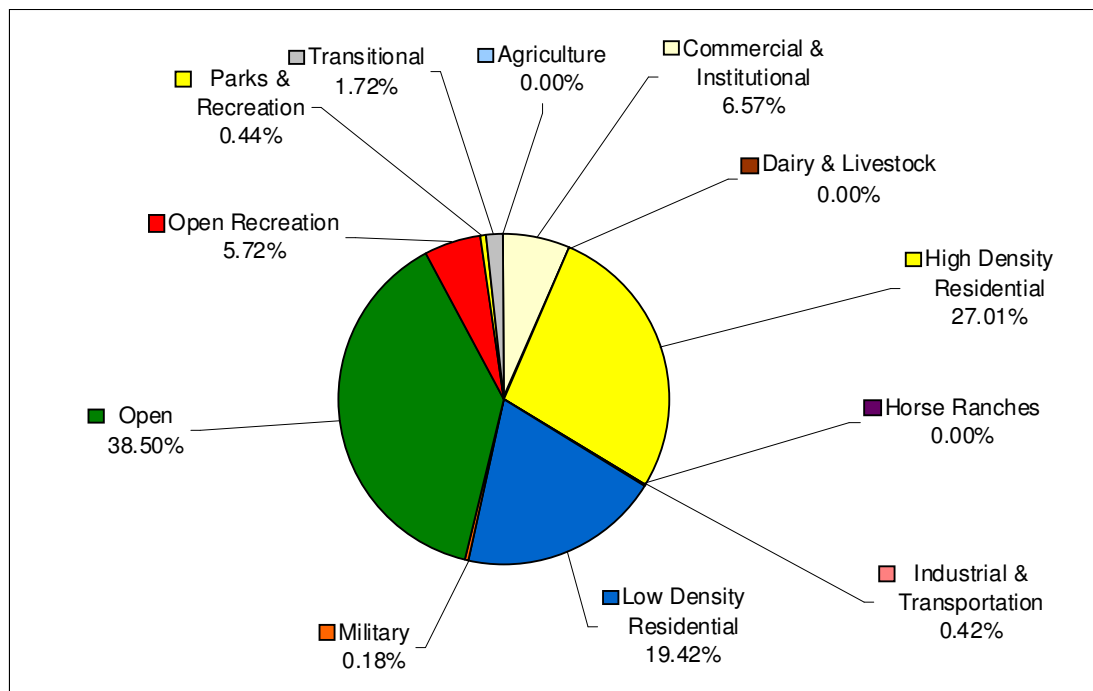


Figure I-17. Percent of Fecal Coliform Load Generated by Different Land Uses in the Chollas HSA Watershed

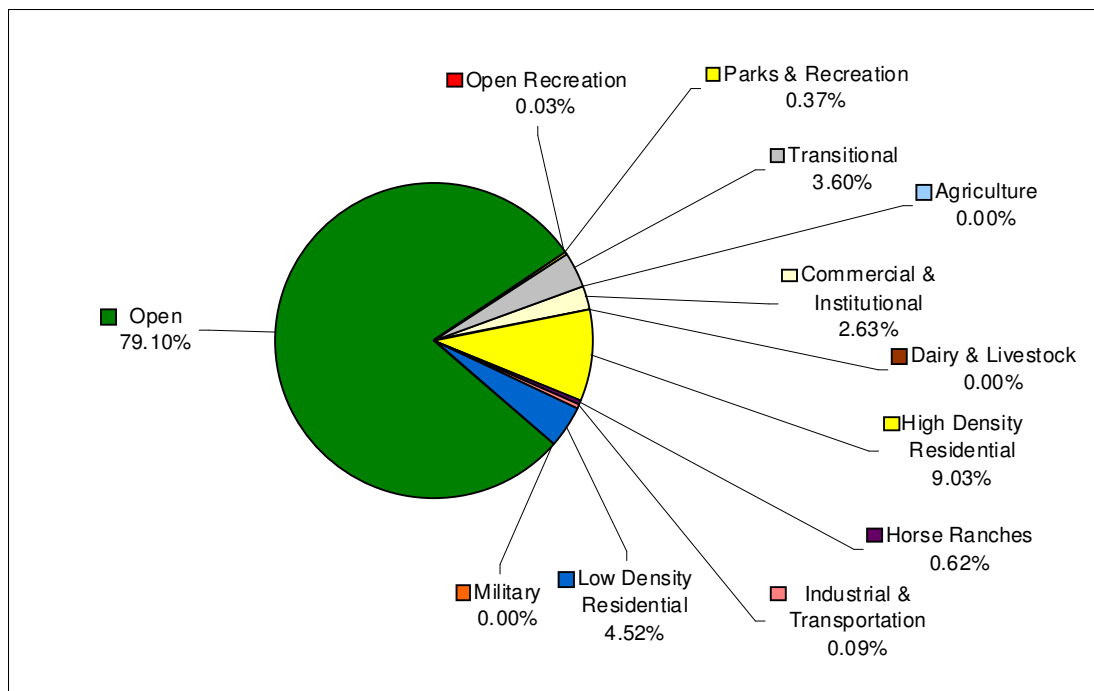


Figure I-18. Percent of Total Coliform Load Generated by Different Land Uses in the San Joaquin Hills HSA/Laguna Beach HSA Watershed

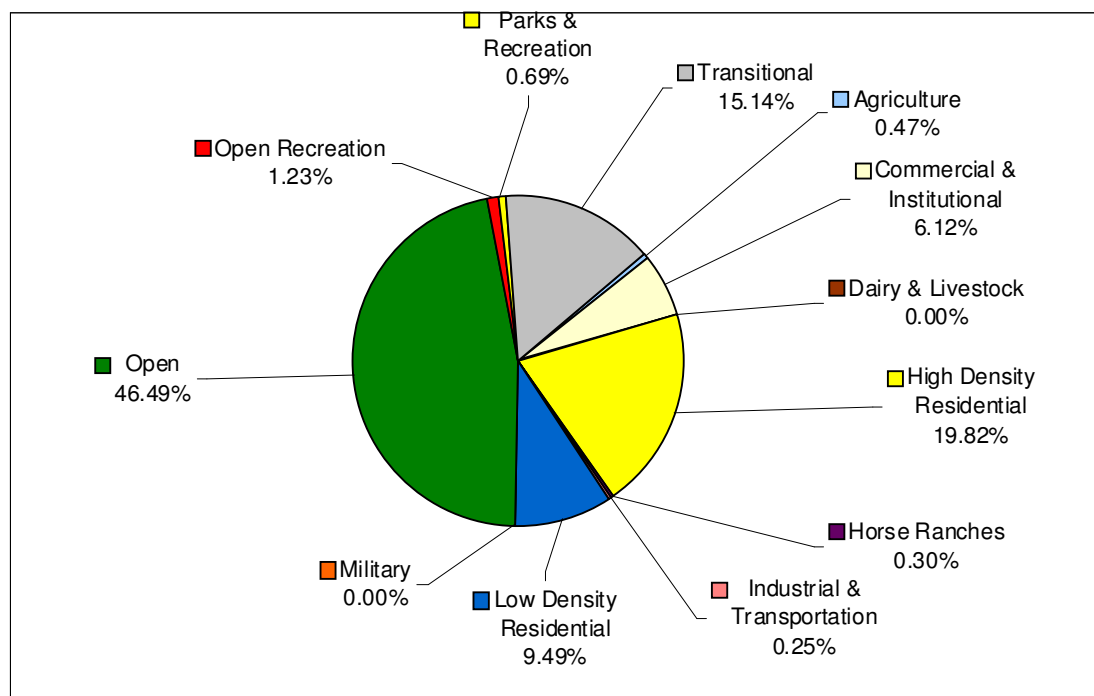


Figure I-19. Percent of Total Coliform Load Generated by Different Land Uses in the Aliso HSA Watershed

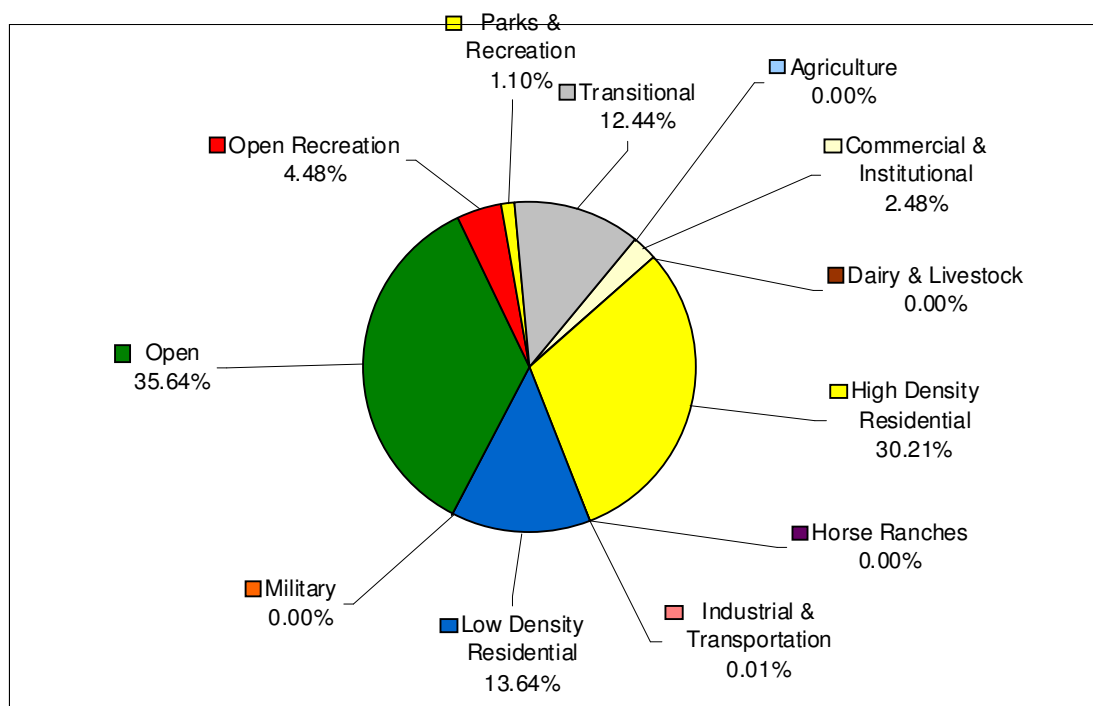


Figure I-20. Percent of Total Coliform Load Generated by Different Land Uses in the Dana Point HSA Watershed

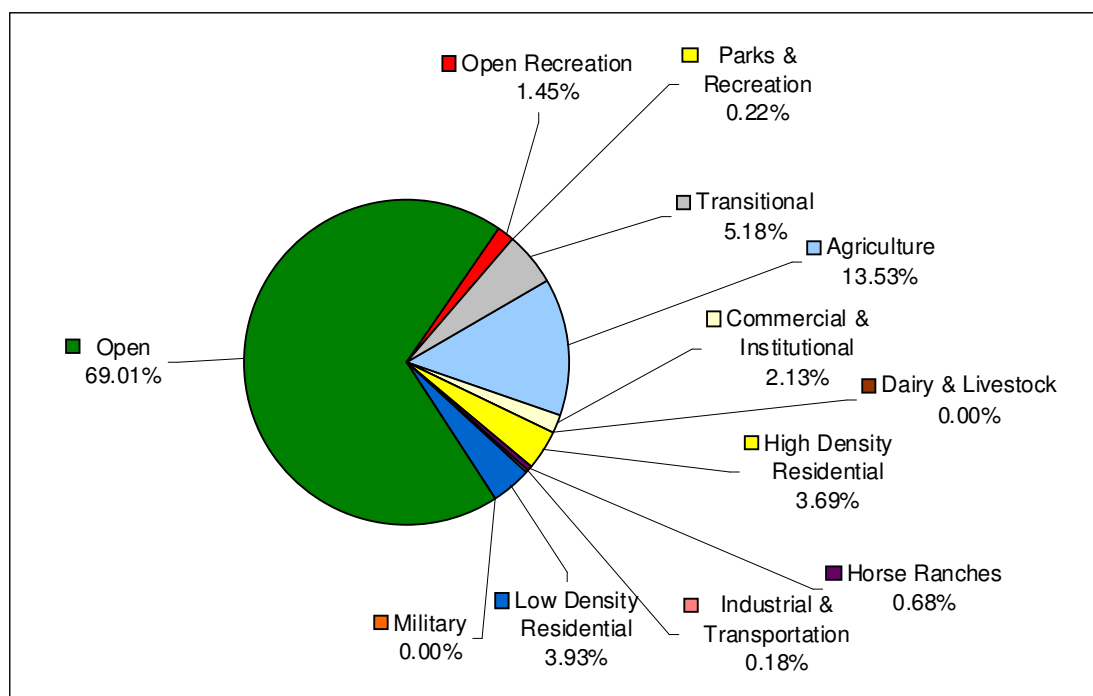


Figure I-21. Percent of Total Coliform Load Generated by Different Land Uses in the Lower San Juan HSA Watershed

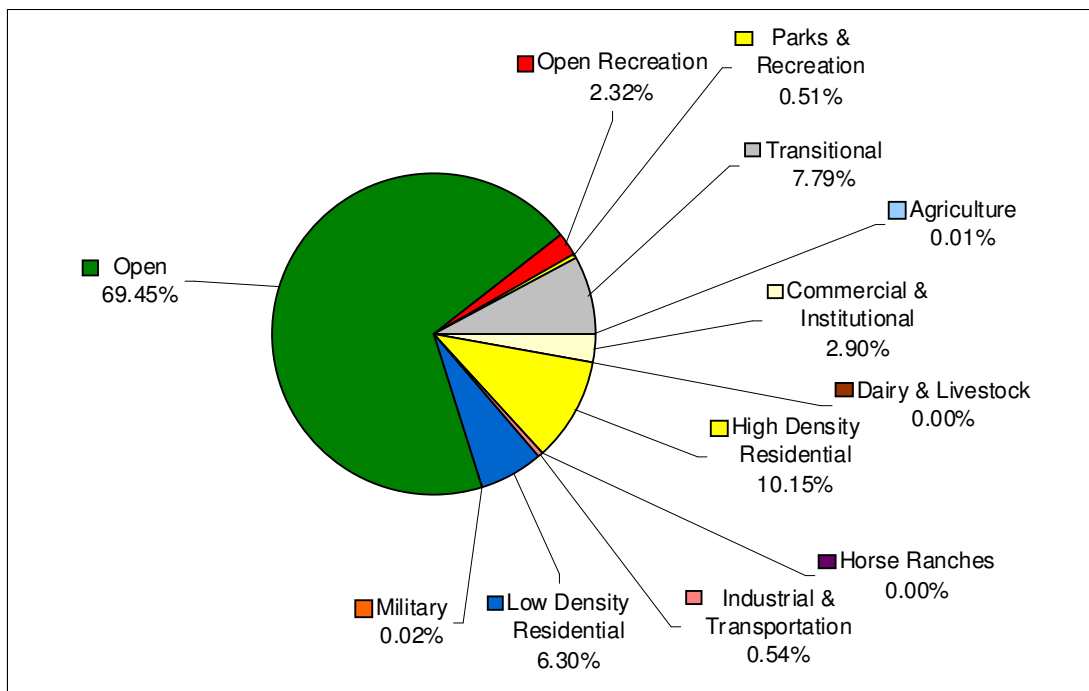


Figure I-22. Percent of Total Coliform Load Generated by Different Land Uses in the San Clemente HA Watershed

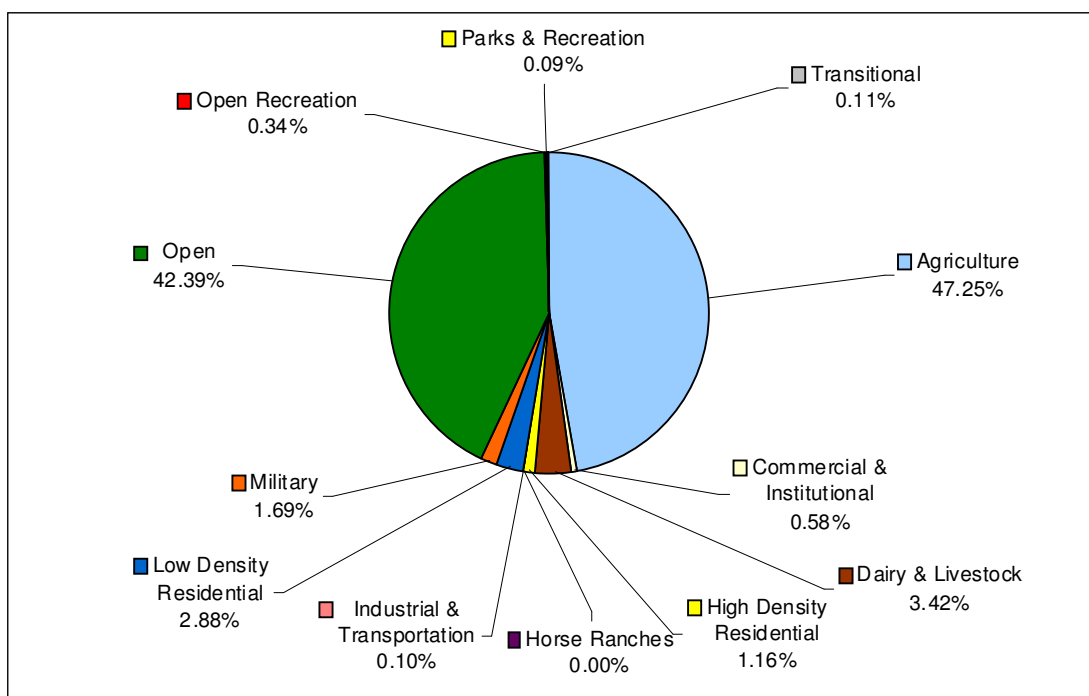


Figure I-23. Percent of Total Coliform Load Generated by Different Land Uses in the San Luis Rey HU Watershed

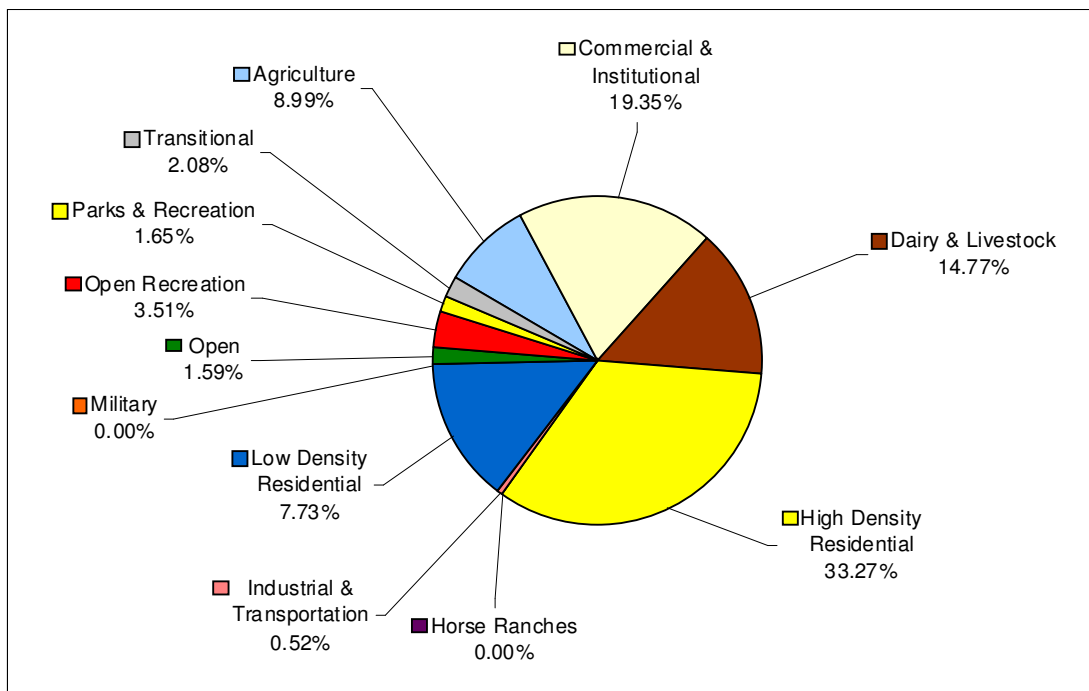


Figure I-24. Percent of Total Coliform Load Generated by Different Land Uses in the San Marcos HA Watershed

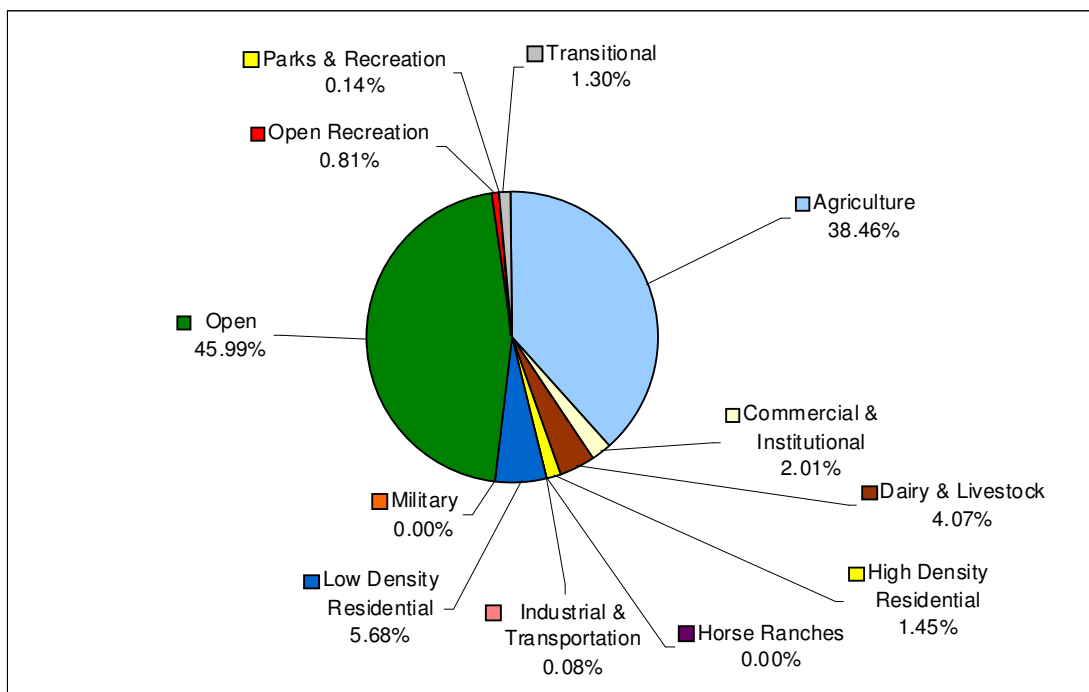


Figure I-25. Percent of Total Coliform Load Generated by Different Land Uses in the San Dieguito HU Watershed

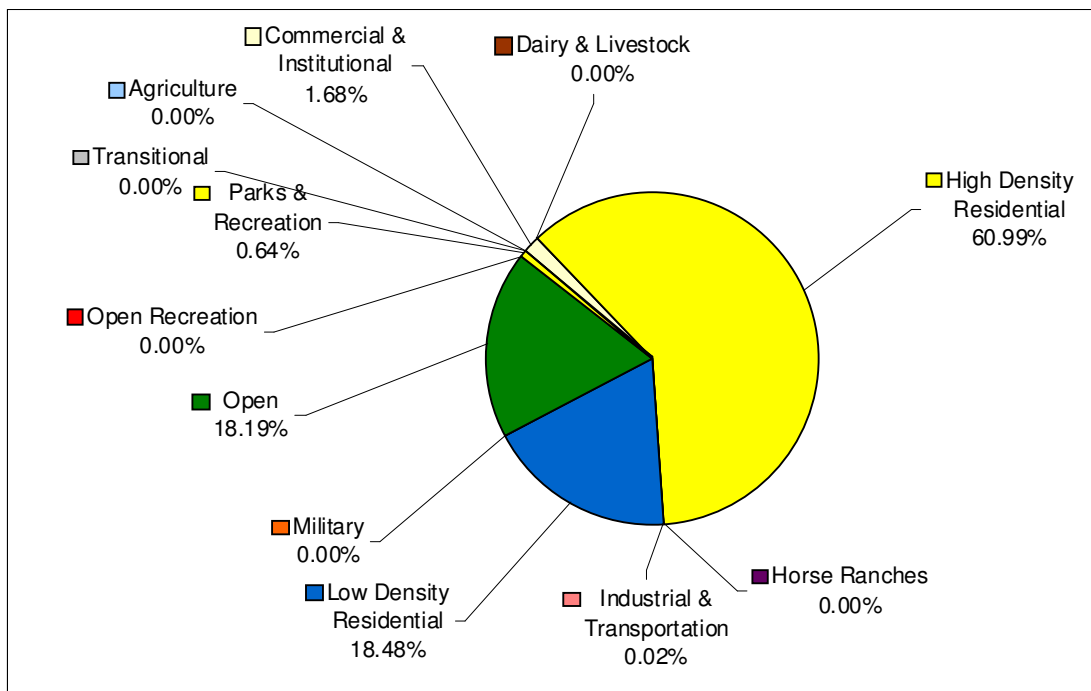


Figure I-26. Percent of Total Coliform Load Generated by Different Land Uses in the Miramar Reservoir HA Watershed

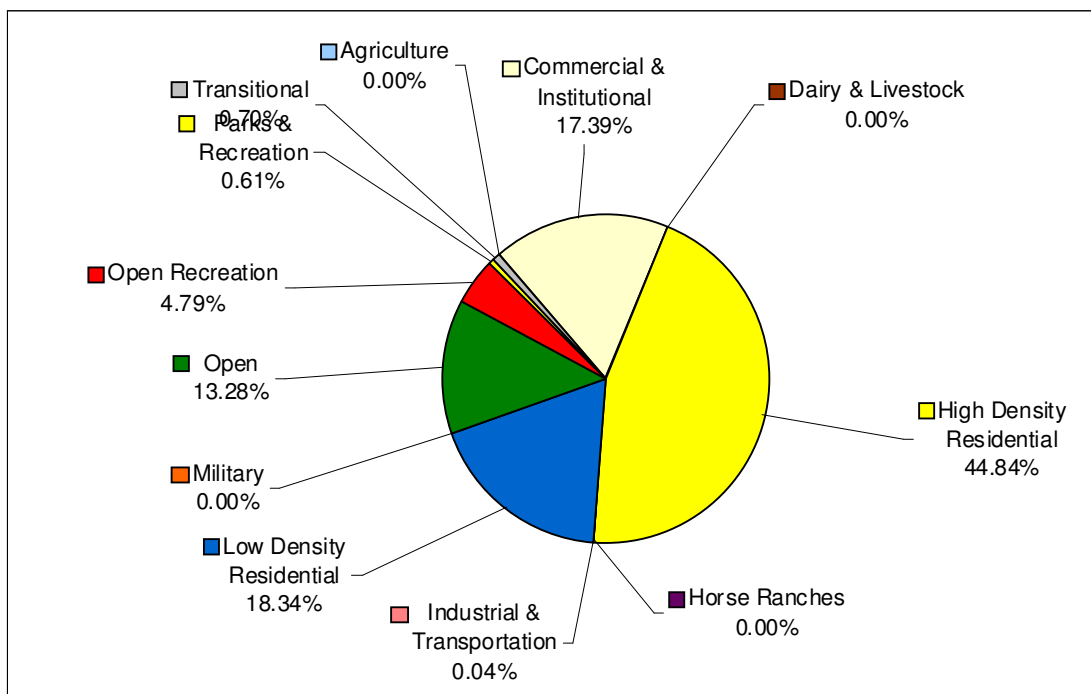


Figure I-27. Percent of Total Coliform Load Generated by Different Land Uses in the Scripps HA Watershed

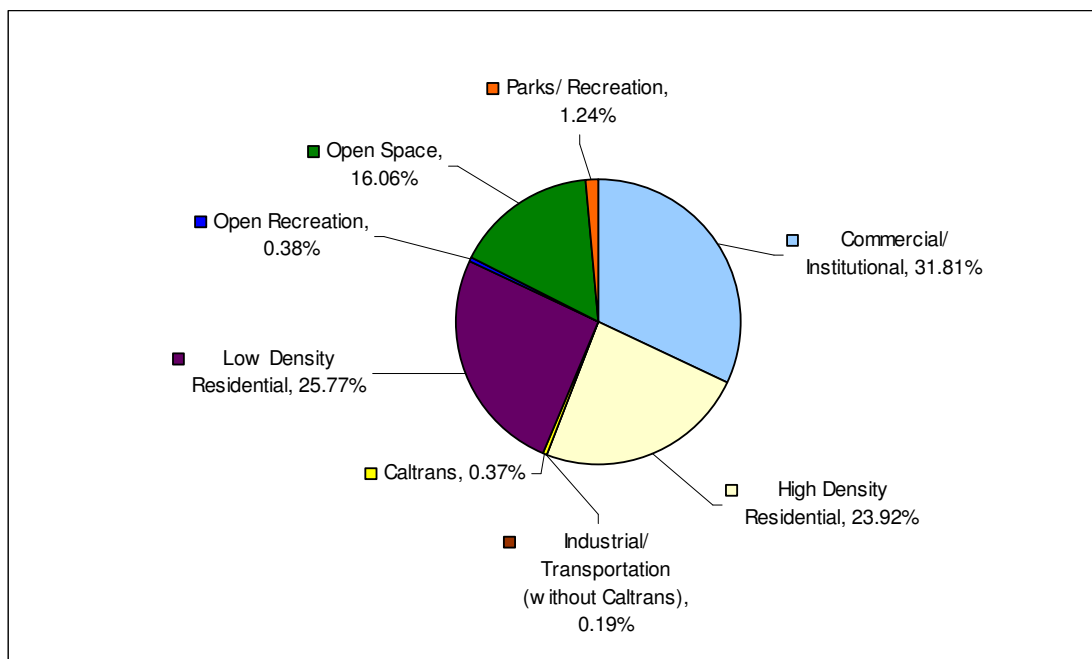


Figure I-28. Percent of Total Coliform Load Generated by Different Land Uses in the Tecolote HA Watershed

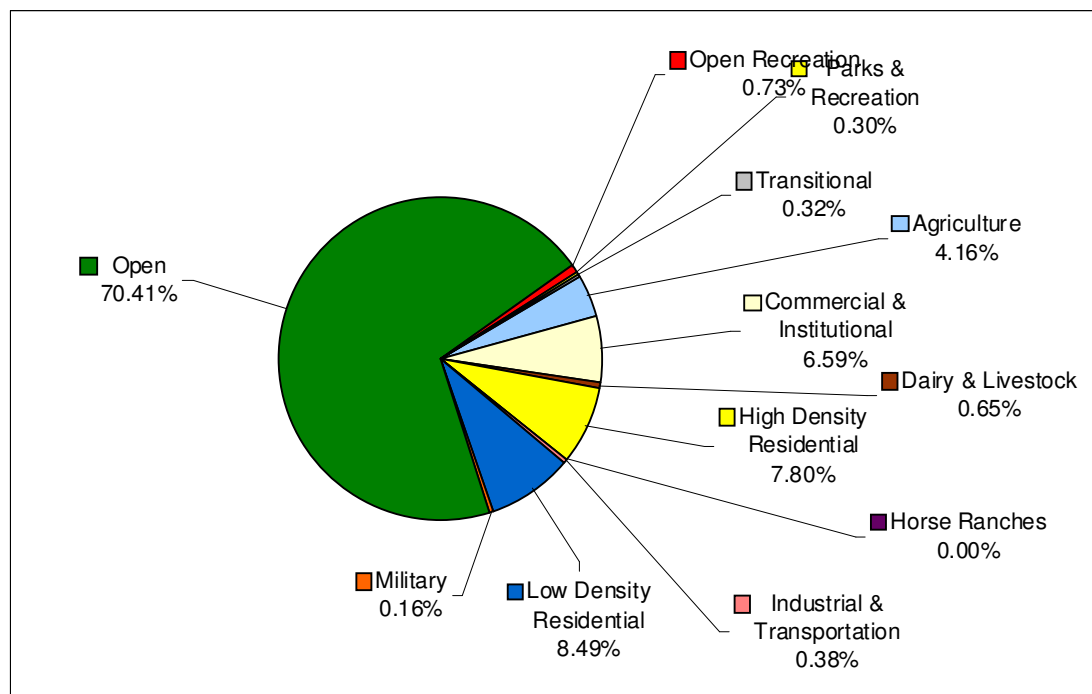


Figure I-29. Percent of Total Coliform Load Generated by Different Land Uses in the Mission San Diego HSA/ Santee HSA Watershed

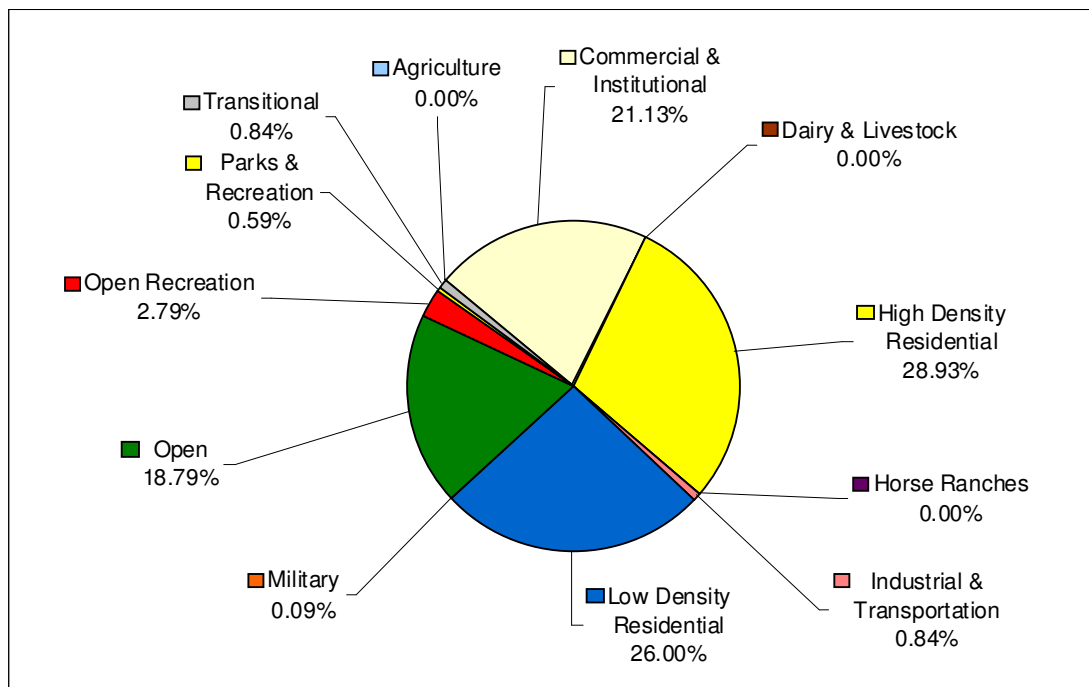


Figure I-30. Percent of Total Coliform Load Generated by Different Land Uses in the Chollas HSA Watershed

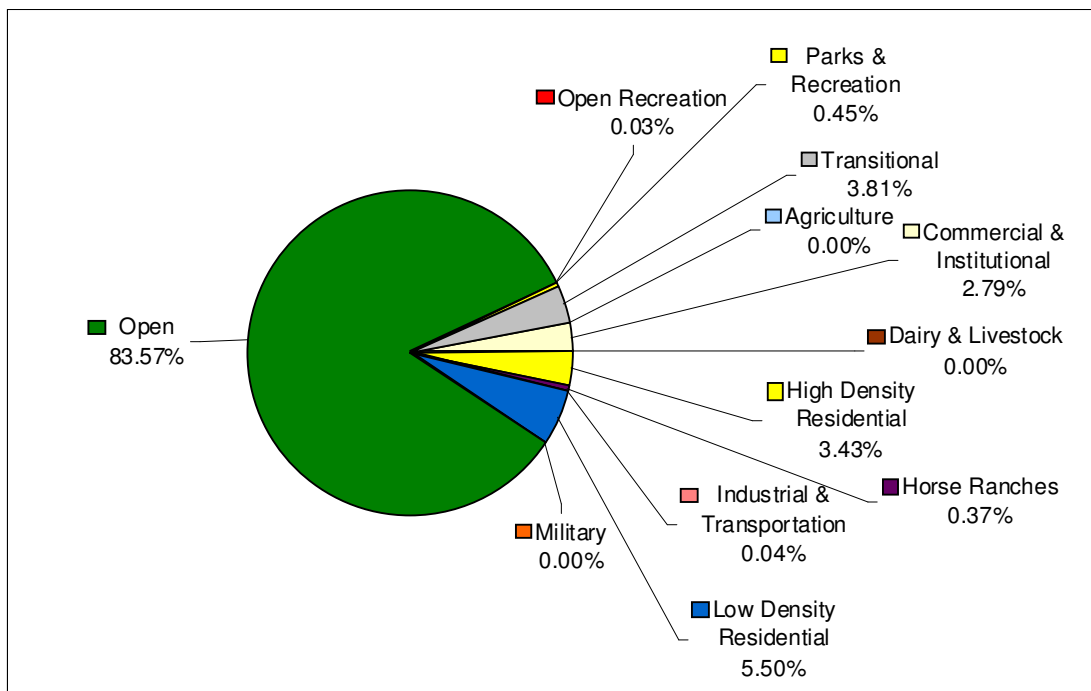


Figure I-31. Percent of Enterococci Load Generated by Different Land Uses in the San Joaquin Hills HSA/Laguna Beach HSA Watershed

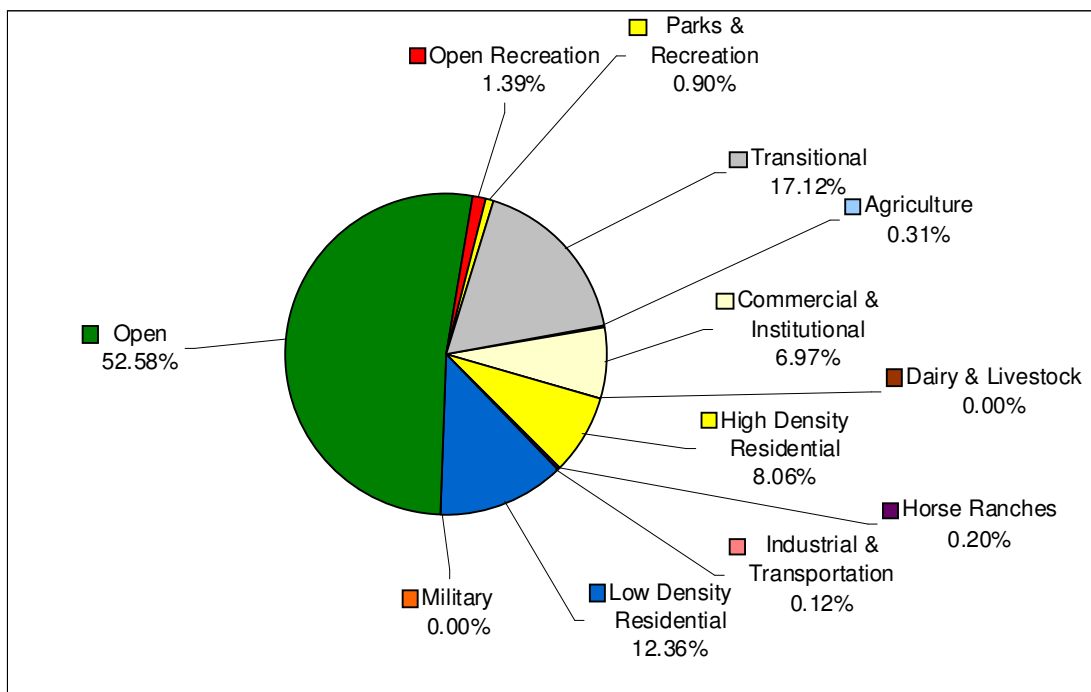


Figure I-32. Percent of Enterococci Load Generated by Different Land Uses in the Aliso HSA Watershed

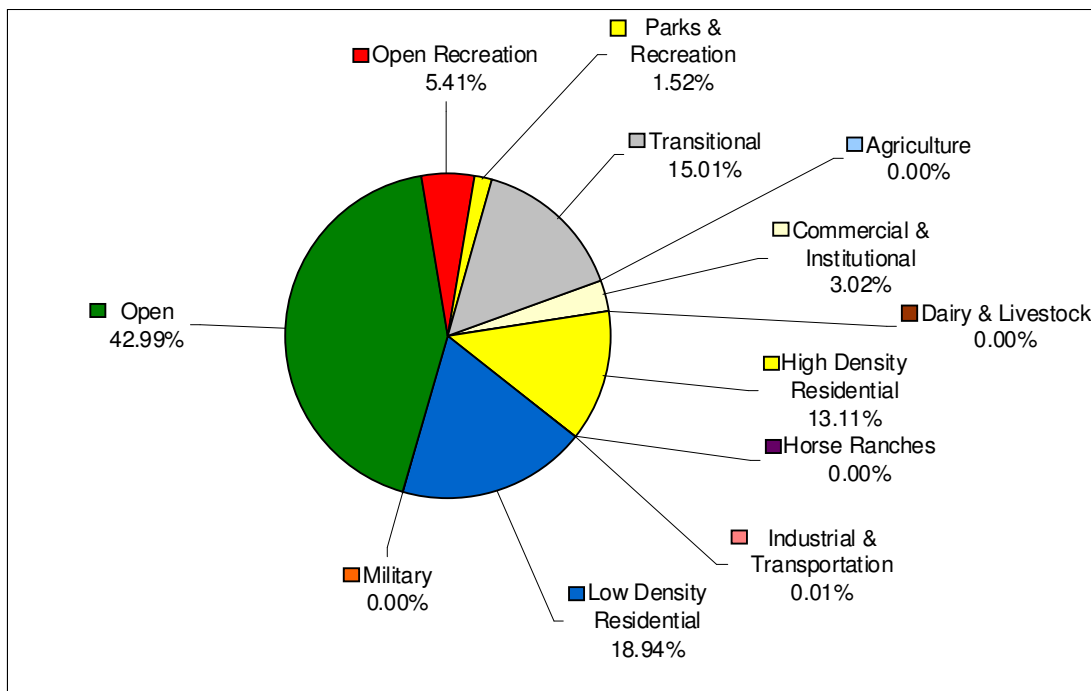


Figure I-33. Percent of Enterococci Load Generated by Different Land Uses in the Dana Point HSA Watershed

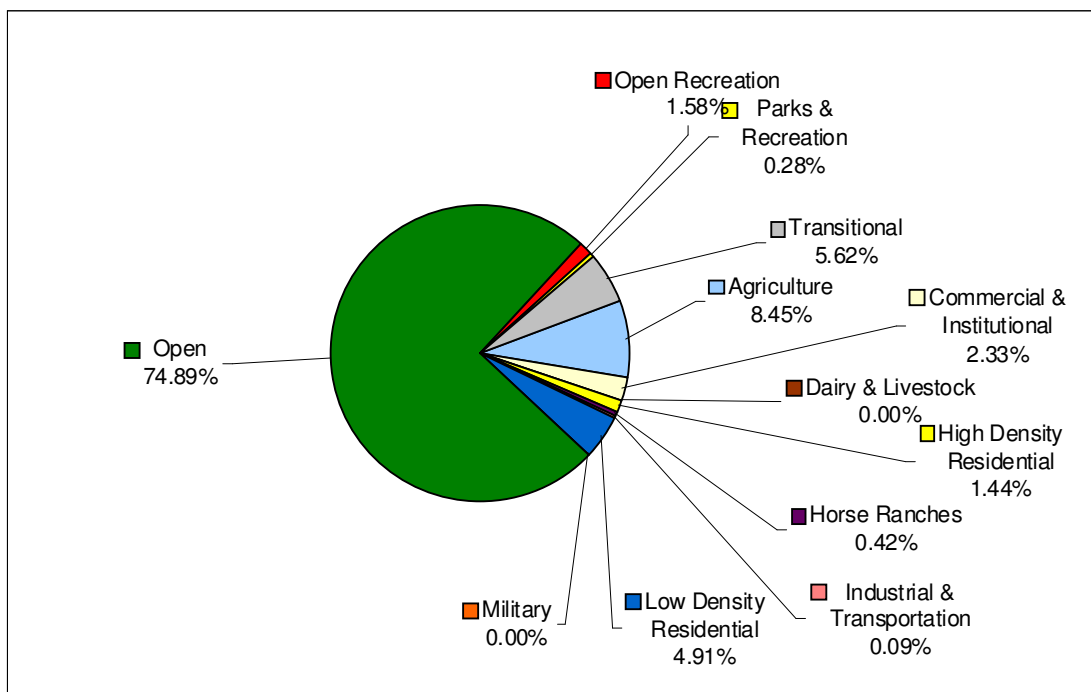


Figure I-34. Percent of Enterococci Load Generated by Different Land Uses in the Lower San Juan HSA Watershed

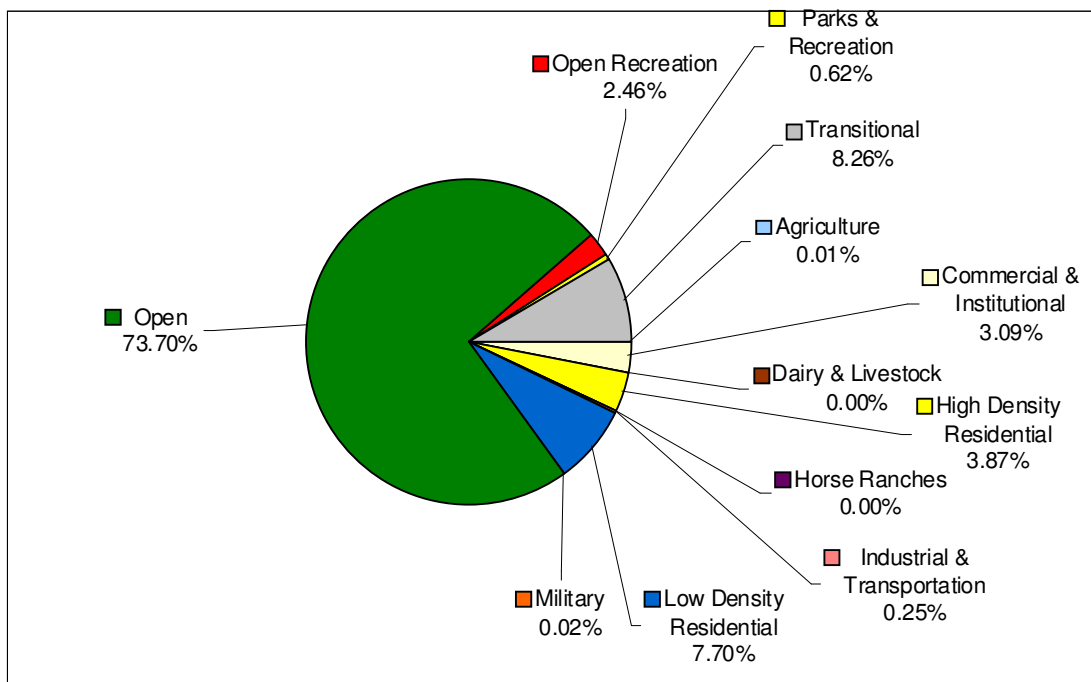


Figure I-35. Percent of Enterococci Load Generated by Different Land Uses in the San Clemente HA Watershed

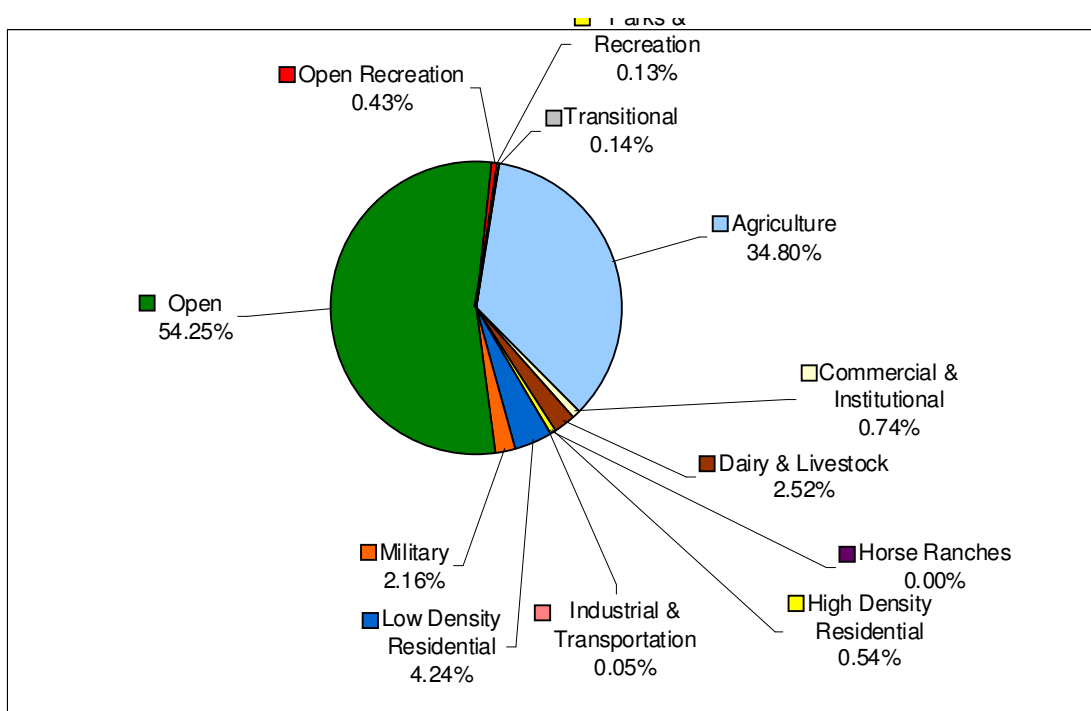


Figure I-36. Percent of Enterococci Load Generated by Different Land Uses in the San Luis Rey HU Watershed

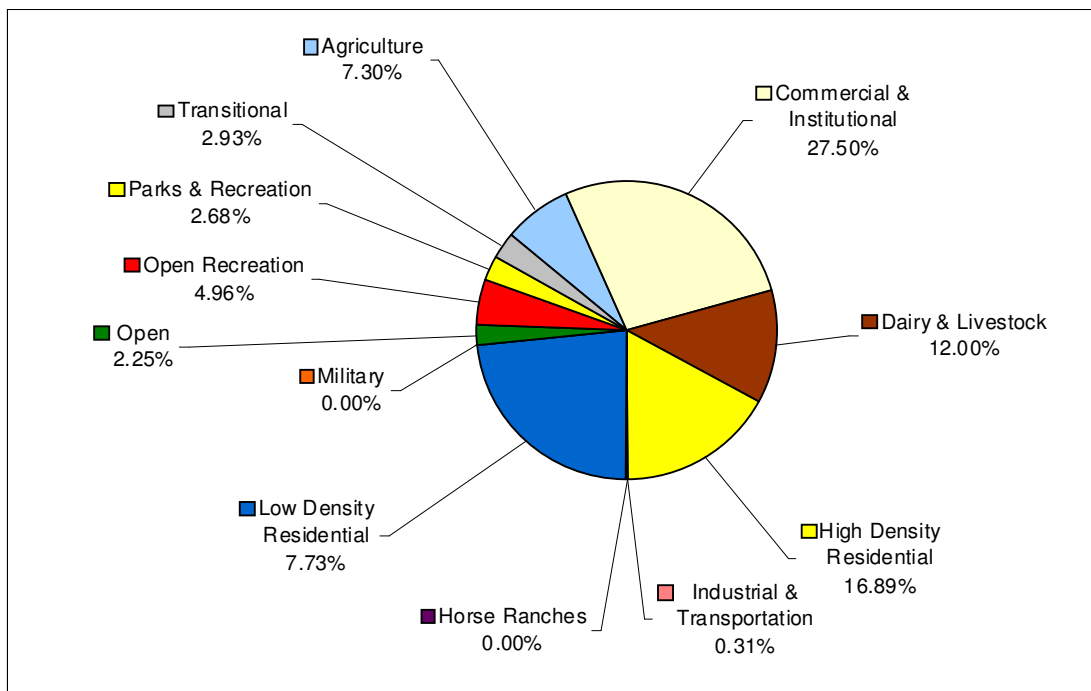


Figure I-37. Percent of Enterococci Load Generated by Different Land Uses in the San Marcos HA Watershed

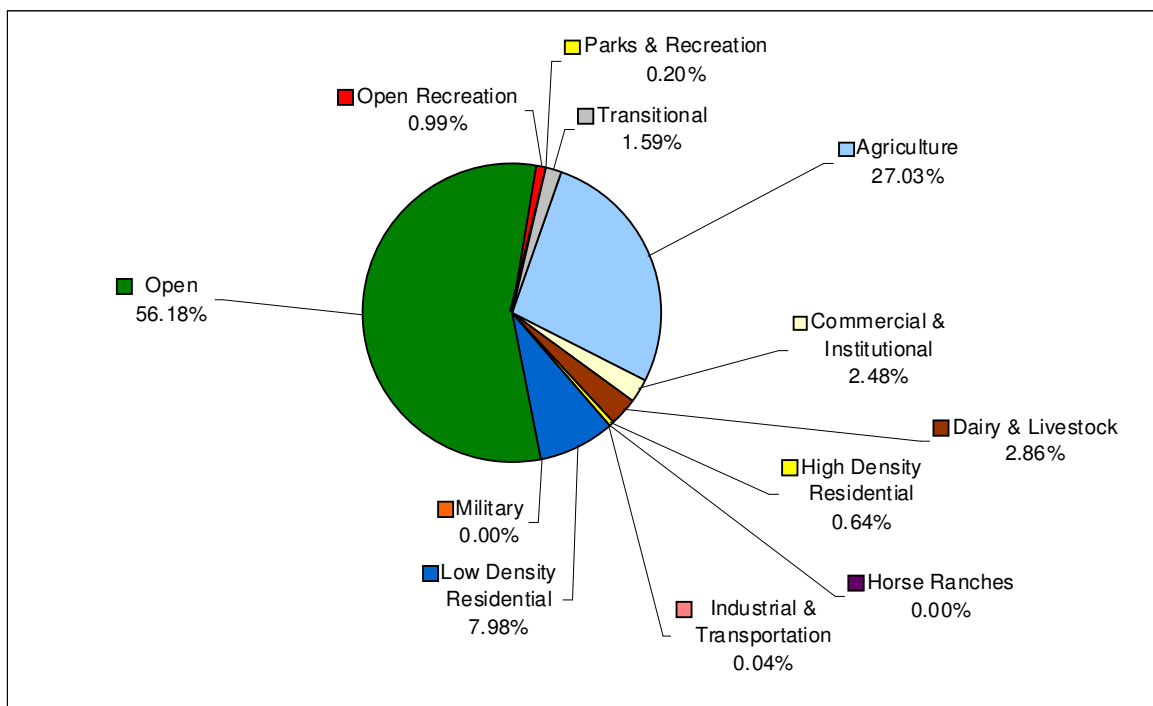


Figure I-38. Percent of Enterococci Load Generated by Different Land Uses in the San Dieguito HU Watershed

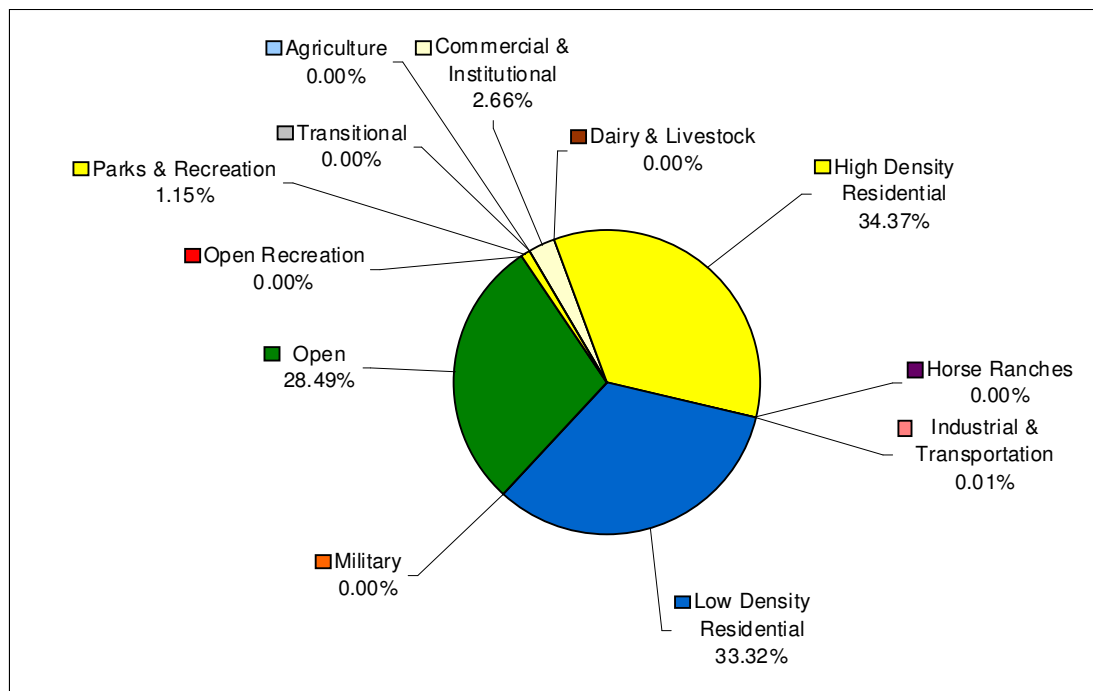


Figure I-39. Percent of Enterococci Load Generated by Different Land Uses in the Miramar Reservoir HA Watershed

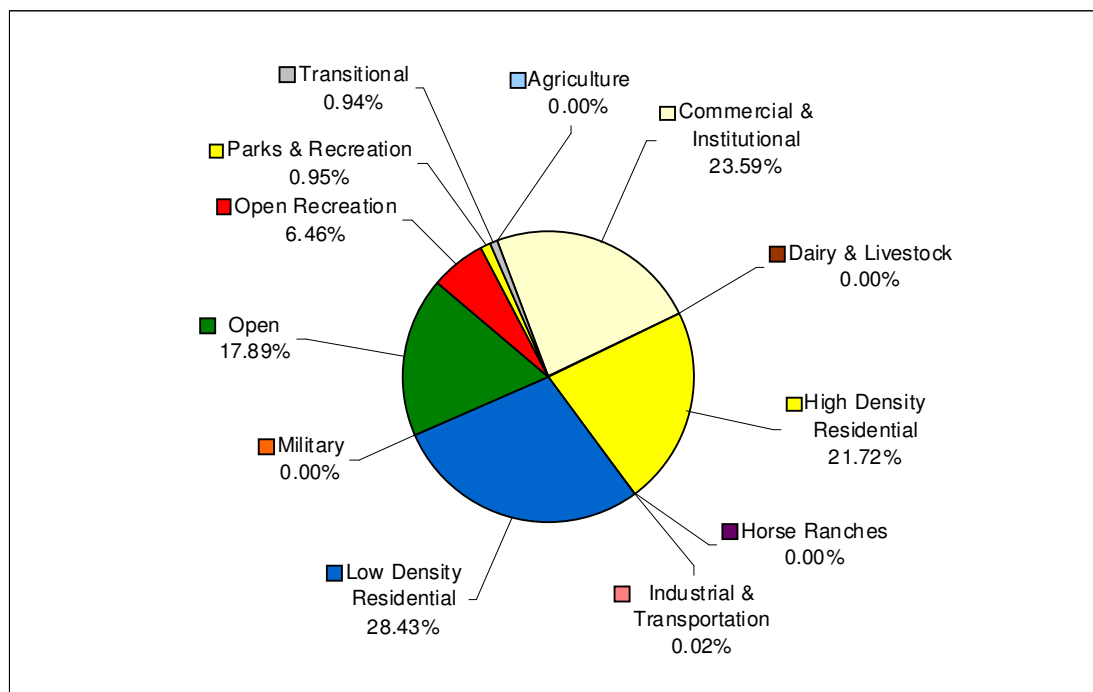


Figure I-40. Percent of Enterococci Load Generated by Different Land Uses in the Scripps HA Watershed

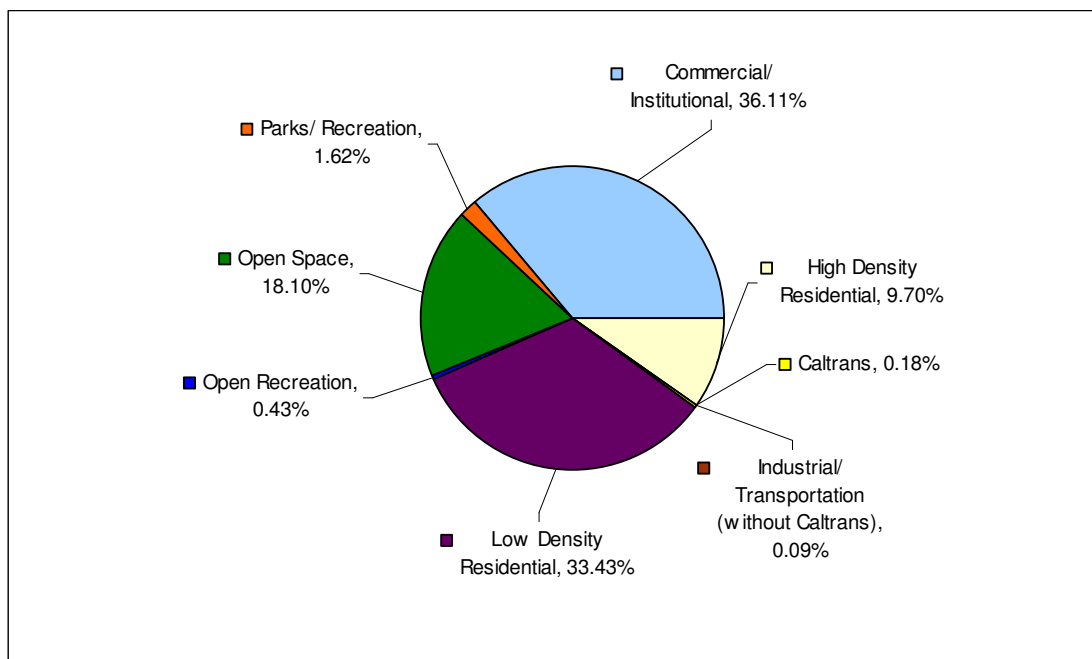


Figure I-41. Percent of Enterococci Load Generated by Different Land Uses in the Tecolote HA Watershed

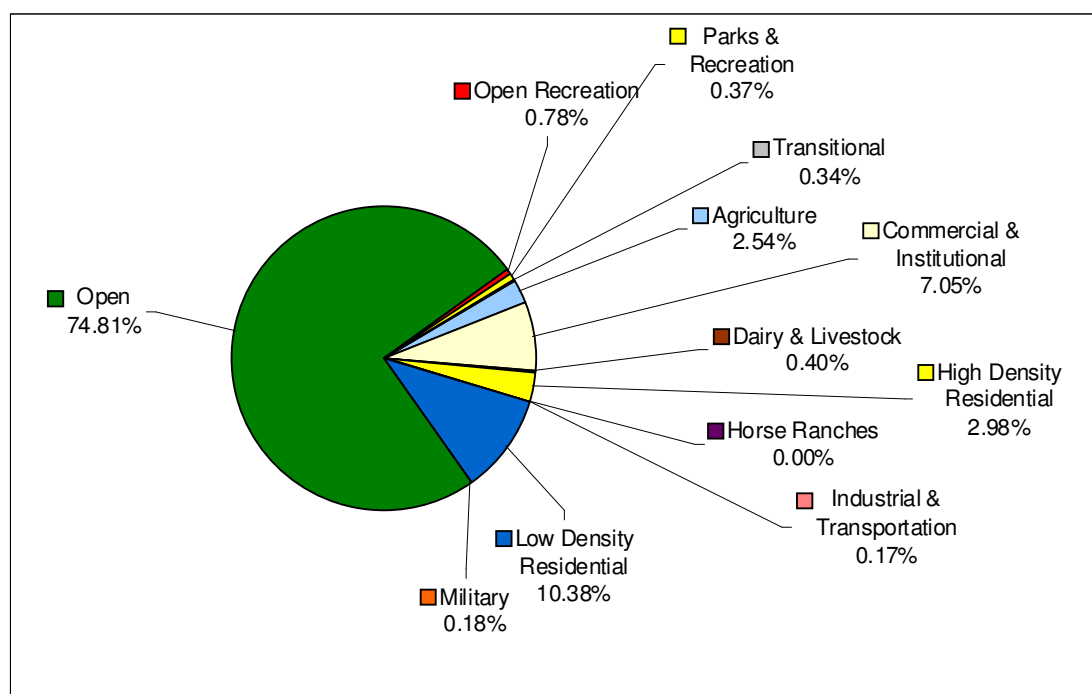


Figure I-42. Percent of Enterococci Load Generated by Different Land Uses in the Mission San Diego HSA/Santee HSA Watershed

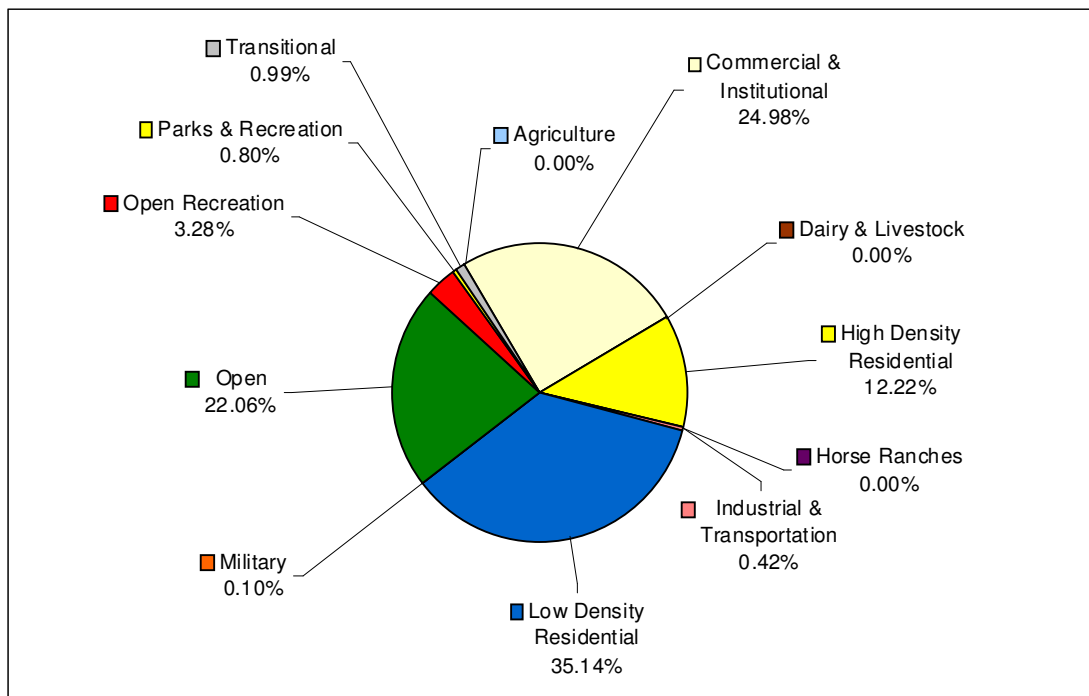


Figure I-43. Percent of Enterococci Load Generated by Different Land Uses in the Chollas HSA Watershed

Table I-12. Fecal Coliform Loads (Billion MPN/year) Generated by Different Land Uses

Watershed	Municipal MS4							CAL TRANS*	Agriculture/Livestock			Open Space			TOTAL
	COMM/ INST	HIDEN RES	LODEN RES	PARK/ REC	MIL	TRANS	IND/ TRANS*		AGRI	DAIRY/ LIVSTK	HORSE RANCH	OPEN SPACE	OPEN REC	WATER	
San Joaquin Hills HSA/ Laguna Beach HSA	3,123 0.44%	32,219 4.57%	12,911 1.83%	1,065 0.15%	0 0.00%	28,229 4.00%	0 0.00%	179 0.03%	12 0.00%	0 0.00%	7,334 1.04%	619,697 87.90%	245 0.03%	0 0.00%	705,015 100.00%
Aliso HSA	20,935 1.19%	203,419 11.61%	77,956 4.45%	5,649 0.32%	0 0.00%	341,034 19.46%	1,099 0.06%	260 0.01%	16,124 0.92%	0 0.00%	10,384 0.59%	1,047,472 59.78%	27,765 1.58%	0 0.00%	1,752,096 100.00%
Dana Point HSA	2,113 0.52%	77,115 19.09%	27,864 6.90%	2,239 0.55%	0 0.00%	69,712 17.26%	0 0.00%	13 0.00%	0 0.00%	0 0.00%	0 0.00%	199,729 49.45%	25,125 6.22%	0 0.00%	403,911 100.00%
Lower San Juan HSA	49,127 0.32%	255,357 1.67%	217,489 1.42%	12,231 0.08%	0 0.00%	787,171 5.14%	5,093 0.03%	1,713 0.01%	3,119,750 20.38%	0 0.00%	155,727 1.02%	10,480,603 68.48%	220,528 1.44%	0 0.00%	15,304,790 100.00%
San Clemente HA	7,263 0.50%	76,380 5.30%	37,951 2.63%	3,079 0.21%	310 0.02%	128,621 8.92%	1,840 0.13%	335 0.02%	366 0.03%	0 0.00%	0 0.00%	1,147,224 79.57%	38,354 2.66%	0 0.00%	1,441,723 100.00%
San Luis Rey HU	23,591 0.07%	142,670 0.43%	281,805 0.85%	8,795 0.03%	453,236 1.37%	28,477 0.09%	4,927 0.01%	1,537 0.00%	19,290,677 58.24%	1,397,277 4.22%	0 0.00%	11,396,020 34.41%	90,999 0.27%	0 0.00%	33,120,012 100.00%
San Marco HA	912 4.37%	4,705 22.53%	1,614 7.73%	187 0.89%	0 0.00%	645 3.09%	31 0.15%	8 0.04%	4,236 20.28%	6,963 33.34%	0 0.00%	495 2.37%	1,090 5.22%	0 0.00%	20,886 100.00%
San Dieguito HU	56,175 0.26%	121,831 0.57%	380,242 1.79%	9,559 0.04%	0 0.00%	239,782 1.13%	2,419 0.01%	1,310 0.01%	10,735,210 50.43%	1,137,030 5.34%	0 0.00%	8,454,478 39.72%	148,874 0.70%	0 0.00%	21,286,910 100.00%
Miramar Reservoir HA	50 0.48%	5,428 52.23%	1,315 12.66%	46 0.44%	0 0.00%	0 0.00%	1 0.01%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	3,552 34.18%	0 0.00%	0 0.00%	10,392 100.00%
Scripps HA	11,051 5.42%	85,490 41.89%	27,976 13.71%	937 0.46%	0 0.00%	2,910 1.43%	40 0.02%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	55,589 27.24%	20,065 9.83%	0 0.00%	204,057 100.00%
Tecolote HA	29,956 11.44%	67,571 25.79%	58,239 22.23%	3,388 1.29%	14 0.01%	0 0.00%	281 0.11%	553 0.21%	0 0.00%	0 0.00%	0 0.00%	99,585 38.01%	2,378 0.91%	0 0.00%	261,966 100.00%
Mission San Diego HSA/ Santee HSA	56,873 1.15%	202,038 4.10%	175,889 3.57%	6,294 0.13%	9,373 0.19%	17,966 0.36%	4,227 0.09%	1,009 0.02%	358,880 7.28%	55,841 1.13%	0 0.00%	4,002,217 81.14%	41,774 0.85%	0 0.00%	4,932,380 100.00%
Chollas HSA	39,703 6.57%	163,125 27.01%	117,275 19.42%	2,683 0.44%	1,084 0.18%	10,404 1.72%	1,627 0.27%	892 0.15%	0 0.00%	0 0.00%	0 0.00%	232,504 38.50%	34,566 5.72%	0 0.00%	603,863 100.00%

* See Table I-15 for how fecal coliform bacteria loads from Caltrans land use areas are separated from Industrial/Transportation land use areas

Table I-13. Total Coliform Loads (Billion MPN/year) Generated by Different Land Uses

Watershed	Municipal MS4							CAL TRANS*	Agriculture/Livestock			Open Space			TOTAL
	COMM/ INST	HIDEN RES	LODEN RES	PARK/ REC	MIL	TRANS	IND/ TRANS*		AGRI	DAIRY/ LIVSTK	HORSE RANCH	OPEN SPACE	OPEN REC	WATER	
San Joaquin Hills HSA/ Laguna Beach HSA	215,853 2.63%	742,277 9.03%	371,822 4.52%	30,674 0.37%	0 0.00%	296,278 3.60%	0 0.00%	7,722 0.09%	86 0.00%	0 0.00%	50,688 0.62%	6,503,925 79.10%	2,576 0.03%	0 0.00%	8,221,901 100.00%
Aliso HSA	1,420,213 6.12%	4,599,980 19.82%	2,203,565 9.49%	159,674 0.69%	0 0.00%	3,513,206 15.14%	46,603 0.20%	11,003 0.05%	109,385 0.47%	0 0.00%	70,443 0.30%	10,790,677 46.49%	286,025 1.23%	0 0.00%	23,210,774 100.00%
Dana Point HSA	162,592 2.48%	1,977,554 30.21%	893,185 13.64%	71,764 1.10%	0 0.00%	814,402 12.44%	0 0.00%	634 0.01%	0 0.00%	0 0.00%	0 0.00%	2,333,311 35.64%	293,519 4.48%	0 0.00%	6,546,962 100.00%
Lower San Juan HSA	2,774,700 2.13%	4,807,521 3.69%	5,118,237 3.93%	287,838 0.22%	0 0.00%	6,751,244 5.18%	179,782 0.14%	60,480 0.05%	17,620,337 13.53%	0 0.00%	879,547 0.68%	89,887,797 69.01%	1,891,381 1.45%	0 0.00%	130,258,863 100.00%
San Clemente HA	470,171 2.90%	1,648,096 10.15%	1,023,612 6.30%	83,059 0.51%	3,051 0.02%	1,264,318 7.79%	74,436 0.46%	13,534 0.08%	2,370 0.01%	0 0.00%	0 0.00%	11,276,953 69.45%	377,008 2.32%	0 0.00%	16,236,606 100.00%
San Luis Rey HU	1,338,298 0.58%	2,697,850 1.16%	6,661,047 2.88%	207,883 0.09%	3,904,364 1.69%	245,311 0.11%	174,704 0.08%	54,508 0.02%	109,434,181 47.25%	7,926,619 3.42%	0 0.00%	98,170,007 42.39%	783,906 0.34%	0 0.00%	231,598,677 100.00%
San Marco HA	99,702 19.35%	171,443 33.27%	73,530 14.27%	8,513 1.65%	0 0.00%	10,702 2.08%	2,131 0.41%	533 0.10%	46,303 8.99%	76,110 14.77%	0 0.00%	8,214 1.59%	18,097 3.51%	0 0.00%	515,278 100.00%
San Dieguito HU	3,290,924 2.01%	2,379,081 1.45%	9,281,579 5.68%	233,330 0.14%	0 0.00%	2,133,097 1.30%	88,558 0.05%	47,969 0.03%	62,890,325 38.46%	6,661,091 4.07%	0 0.00%	75,210,801 45.99%	1,324,377 0.81%	0 0.00%	163,541,133 100.00%
Miramar Reservoir HA	3,586 1.68%	129,908 60.99%	39,357 18.48%	1,362 0.64%	0 0.00%	0 0.00%	30 0.01%	9 0.00%	0 0.00%	0 0.00%	0 0.00%	38,734 18.19%	0 0.00%	0 0.00%	212,986 100.00%
Scripps HA	874,595 17.39%	2,255,304 44.84%	922,557 18.34%	30,893 0.61%	0 0.00%	34,969 0.70%	1,993 0.04%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	668,068 13.28%	241,141 4.79%	0 0.00%	5,029,519 100.00%
Tecolote HA	2,352,810 31.81%	1,769,021 23.92%	1,905,887 25.77%	110,886 1.50%	93 0.00%	0 0.00%	13,788 0.19%	27,095 0.37%	0 0.00%	0 0.00%	0 0.00%	1,187,711 16.06%	28,366 0.38%	0 0.00%	7,395,789 100.00%
Mission San Diego HSA/ Santee HSA	4,794,240 6.59%	5,677,064 7.80%	6,177,862 8.49%	221,053 0.30%	119,975 0.16%	229,973 0.32%	222,699 0.31%	53,141 0.07%	3,025,241 4.16%	470,719 0.65%	0 0.00%	51,230,867 70.41%	534,734 0.73%	0 0.00%	72,757,569 100.00%
Chollas HSA	3,251,407 21.13%	4,452,966 28.93%	4,001,695 26.00%	91,547 0.59%	13,477 0.09%	129,379 0.84%	83,294 0.54%	45,652 0.30%	0 0.00%	0 0.00%	0 0.00%	2,891,344 18.79%	429,847 2.79%	0 0.00%	15,390,608 100.00%

* See Table I-16 for how total coliform bacteria loads from Caltrans land use areas are separated from Industrial/Transportation land use areas

Table I-14. Enterococci Loads (Billion MPN/year) Generated by Different Land Uses

Watershed	Municipal MS4							CAL TRANS*	Agriculture/Livestock			Open Space			TOTAL
	COMM/ INST	HIDEN RES	LODEN RES	PARK/ REC	MIL	TRANS	IND/ TRANS*		AGRI	DAIRY/ LIVSTK	HORSE RANCH	OPEN SPACE	OPEN REC	WATER	
San Joaquin Hills HSA/ Laguna Beach HSA	23,814 2.79%	29,247 3.43%	46,881 5.50%	3,867 0.45%	0 0.00%	32,458 3.81%	0 0.00%	365 0.04%	5 0.00%	0 0.00%	3,195 0.37%	712,533 83.57%	282 0.03%	0 0.00%	852,649 100.00%
Aliso HSA	155,419 6.97%	179,783 8.06%	275,593 12.36%	19,970 0.90%	0 0.00%	381,783 17.12%	2,186 0.10%	516 0.02%	6,840 0.31%	0 0.00%	4,405 0.20%	1,172,631 52.58%	31,083 1.39%	0 0.00%	2,230,206 100.00%
Dana Point HSA	15,131 3.02%	65,726 13.11%	94,996 18.94%	7,633 1.52%	0 0.00%	75,261 15.01%	0 0.00%	25 0.01%	0 0.00%	0 0.00%	0 0.00%	215,628 42.99%	27,125 5.41%	0 0.00%	501,526 100.00%
Lower San Juan HSA	302,177 2.33%	186,986 1.44%	637,026 4.91%	35,825 0.28%	0 0.00%	730,116 5.62%	8,391 0.06%	2,823 0.02%	1,096,531 8.45%	0 0.00%	54,735 0.42%	9,720,946 74.89%	204,544 1.58%	0 0.00%	12,980,098 100.00%
San Clemente HA	51,464 3.09%	64,428 3.87%	128,049 7.70%	10,390 0.62%	332 0.02%	137,426 8.26%	3,492 0.21%	635 0.04%	148 0.01%	0 0.00%	0 0.00%	1,225,757 73.70%	40,979 2.46%	0 0.00%	1,663,100 100.00%
San Luis Rey HU	137,330 0.74%	98,872 0.54%	781,175 4.24%	24,380 0.13%	397,857 2.16%	24,997 0.14%	7,683 0.04%	2,397 0.01%	6,416,957 34.80%	464,798 2.52%	0 0.00%	10,003,592 54.25%	79,881 0.43%	0 0.00%	18,439,920 100.00%
San Marco HA	11,154 27.50%	6,850 16.89%	9,401 23.18%	1,088 2.68%	0 0.00%	1,189 2.93%	102 0.25%	26 0.06%	2,960 7.30%	4,865 12.00%	0 0.00%	912 2.25%	2,010 4.96%	0 0.00%	40,558 100.00%
San Dieguito HU	366,288 2.48%	94,571 0.64%	1,180,642 7.98%	29,680 0.20%	0 0.00%	235,764 1.59%	4,224 0.03%	2,288 0.02%	3,999,911 27.03%	423,655 2.86%	0 0.00%	8,312,808 56.18%	146,379 0.99%	0 0.00%	14,796,210 100.00%
Miramar Reservoir HA	307 2.66%	3,974 34.37%	3,853 33.32%	133 1.15%	0 0.00%	0 0.00%	1 0.01%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	3,295 28.49%	0 0.00%	0 0.00%	11,564 100.00%
Scripps HA	89,116 23.59%	82,072 21.72%	107,432 28.43%	3,597 0.95%	0 0.00%	3,538 0.94%	87 0.02%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	67,598 17.89%	24,399 6.46%	0 0.00%	377,839 100.00%
Tecolote HA	255,786 36.11%	68,685 9.70%	236,798 33.43%	13,777 1.95%	18 0.00%	0 0.00%	644 0.09%	1,266 0.18%	0 0.00%	0 0.00%	0 0.00%	128,222 18.10%	3,062 0.43%	0 0.00%	708,256 100.00%
Mission San Diego HSA/ Santee HSA	511,533 7.05%	216,332 2.98%	753,328 10.38%	26,955 0.37%	12,712 0.18%	24,367 0.34%	10,183 0.14%	2,430 0.03%	184,449 2.54%	28,700 0.40%	0 0.00%	5,428,113 74.81%	56,657 0.78%	0 0.00%	7,255,759 100.00%
Chollas HSA	342,748 24.98%	167,647 12.22%	482,103 35.14%	11,029 0.80%	1,411 0.10%	13,544 0.99%	3,763 0.27%	2,062 0.15%	0 0.00%	0 0.00%	0 0.00%	302,668 22.06%	44,997 3.28%	0 0.00%	1,371,972 100.00%

* See Table I-17 for how *Enterococci* bacteria loads from Caltrans land use areas are separated from Industrial/Transportation land use areas

Table I-15. Loads Generated by Caltrans: Fecal Coliform

Watershed	IND/ TRANS Land Use Total Load ^a (Billion MPN/yr)	IND/TRANS GIS-Based Land Use Area ^b (sq mi)	CALTRANS Land Use Area ^c (sq mi)	IND/ TRANS Land Use w/o CALTRANS Land Use			IND/TRANS Land Use Occupied by CALTRANS Land Use		
				Land Use Area		Bacteria Load (Billion MPN/yr)	Land Use Area		Bacteria Load (Billion MPN/yr)
				(percent)	(sq mi)		(percent)	(sq mi)	
San Joaquin Hills HSA/Laguna Beach HSA ^d	179	0.11	0.19	100.00%	0.11	179	0.00%	0	0
Aliso HSA	1,359	0.89	0.17	19.10%	0.17	260	80.90%	0.72	1,099
Dana Point HSA ^{ad}	13	0.01	0.06	100.00%	0.01	13	0.00%	0	0
Lower San Juan HSA	6,806	2.9	0.73	25.17%	0.73	1,713	74.83%	2.17	5,093
San Clemente HA	2,174	1.17	0.18	15.38%	0.18	335	84.62%	0.99	1,840
San Luis Rey HU	6,465	4.92	1.17	23.78%	1.17	1,537	76.22%	3.75	4,927
San Marcos HA	39	0.05	0.01	20.00%	0.01	8	80.00%	0.04	31
San Dieguito HU	3,729	2.22	0.78	35.14%	0.78	1,310	64.86%	1.44	2,419
Miramar Reservoir HA	1	3.28	0.74	22.56%	0.74	0	77.44%	2.54	1
Scripps HA	40	0.05	0	0.00%	0	0	100.00%	0.05	40
Tecolote HA	834	0.36	0.24	66.27%	0.24	553	33.73%	0.12	281
Mission San Diego HSA/Santee HSA	5,236	10.07	1.94	19.27%	1.94	1,009	80.73%	8.13	4,227
Chollas HSA	2,519	1.61	0.57	35.40%	0.57	892	64.60%	1.04	1,627

a. Total bacteria load generated by Industrial/Transportation land use area calculated by multiplying the total existing load (see Table I-3) by the percent load generated by Industrial & Transportation from Figures I-5 through I-40.

b. Total Industrial/Transportation land use area from GIS land use data (SANDAG 2000)

c. Total Caltrans land use area reported by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005)

d. Caltrans reported area greater than GIS-based land use area in this watershed, therefore 100 percent of load was assumed to be generated by Caltrans land use area.

Table I-16. Loads Generated by Caltrans: Total Coliform

Watershed	IND/ TRANS Land Use Total Load ^a (Billion MPN/yr)	IND/TRANS GIS-Based Land Use Area ^b (sq mi)	CALTRANS Land Use Area ^c (sq mi)	IND/ TRANS Land Use w/o CALTRANS Land Use		Bacteria Load (Billion MPN/yr)	IND/TRANS Land Use Occupied by CALTRANS Land Use		Bacteria Load (Billion MPN/yr)
				Land Use Area (percent)	(sq mi)		Land Use Area (percent)	(sq mi)	
San Joaquin Hills HSA/Laguna Beach HSA ^d	7,722	0.11	0.19	100.00%	0.11	7,722	0.00%	0	0
Aliso HSA	57,606	0.89	0.17	19.10%	0.17	11,003	80.90%	0.72	46,603
Dana Point HSA ^d	634	0.01	0.06	100.00%	0.01	634	0.00%	0	0
Lower San Juan HSA	240,261	2.9	0.73	25.17%	0.73	60,480	74.83%	2.17	179,782
San Clemente HA	87,970	1.17	0.18	15.38%	0.18	13,534	84.62%	0.99	74,436
San Luis Rey HU	229,211	4.92	1.17	23.78%	1.17	54,508	76.22%	3.75	174,704
San Marcos HA	2,664	0.05	0.01	20.00%	0.01	533	80.00%	0.04	2,131
San Dieguito HU	136,527	2.22	0.78	35.14%	0.78	47,969	64.86%	1.44	88,558
Miramar Reservoir HA	39	3.28	0.74	22.56%	0.74	9	77.44%	2.54	30
Scripps HA	1,993	0.05	0	0.00%	0	0	100.00%	0.05	1,993
Tecolote HA	40,883	0.36	0.24	66.27%	0.24	27,095	33.73%	0.12	13,788
Mission San Diego HSA/Santee HSA	275,840	10.07	1.94	19.27%	1.94	53,141	80.73%	8.13	222,699
Chollas HSA	128,945	1.61	0.57	35.40%	0.57	45,652	64.60%	1.04	83,294

a. Total bacteria load generated by Industrial/Transportation land use area calculated by multiplying the total existing load (see Table I-3) by the percent load generated by Industrial & Transportation from Figures I-5 through I-40.

b. Total Industrial/Transportation land use area from GIS land use data (SANDAG 2000)

c. Total Caltrans land use area reported by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005)

d. Caltrans reported area greater than GIS-based land use area in this watershed, therefore 100 percent of load was assumed to be generated by Caltrans land use area.

Table I-17. Loads Generated by Caltrans: Enterococci

Watershed	IND/ TRANS Land Use Total Load ^a (Billion MPN/yr)	IND/TRANS GIS-Based Land Use Area ^b (sq mi)	CALTRANS Land Use Area ^c (sq mi)	IND/ TRANS Land Use w/o CALTRANS Land Use			IND/TRANS Land Use Occupied by CALTRANS Land Use		
				Land Use Area		Bacteria Load (Billion MPN/yr)	Land Use Area		Bacteria Load (Billion MPN/yr)
				(percent)	(sq mi)		(percent)	(sq mi)	
San Joaquin Hills HSA/Laguna Beach HSA ^d	365	0.11	0.19	100.00%	0.11	365	0.00%	0	0
Aliso HSA	2,702	0.89	0.17	19.10%	0.17	516	80.90%	0.72	2,186
Dana Point HSA ^d	25	0.01	0.06	100.00%	0.01	25	0.00%	0	0
Lower San Juan HSA	11,214	2.9	0.73	25.17%	0.73	2,823	74.83%	2.17	8,391
San Clemente HA	4,127	1.17	0.18	15.38%	0.18	635	84.62%	0.99	3,492
San Luis Rey HU	10,080	4.92	1.17	23.78%	1.17	2,397	76.22%	3.75	7,683
San Marcos HA	128	0.05	0.01	20.00%	0.01	26	80.00%	0.04	102
San Dieguito HU	6,512	2.22	0.78	35.14%	0.78	2,288	64.86%	1.44	4,224
Miramar Reservoir HA	1	3.28	0.74	22.56%	0.74	0	77.44%	2.54	1
Scripps HA	87	0.05	0	0.00%	0	0	100.00%	0.05	87
Tecolote HA	1,910	0.36	0.24	66.27%	0.24	1,266	33.73%	0.12	644
Mission San Diego HSA/Santee HSA	12,613	10.07	1.94	19.27%	1.94	2,430	80.73%	8.13	10,183
Chollas HSA	5,826	1.61	0.57	35.40%	0.57	2,062	64.60%	1.04	3,763

- a. Total bacteria load generated by Industrial/Transportation land use area calculated by multiplying the total existing load (see Table I-3) by the percent load generated by Industrial & Transportation from Figures I-5 through I-40.
- b. Total Industrial/Transportation land use area from GIS land use data (SANDAG 2000)
- c. Total Caltrans land use area reported by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005)
- d. Caltrans reported area greater than GIS-based land use area in this watershed, therefore 100 percent of load was assumed to be generated by Caltrans land use area.

Table I-18. Wet Weather Fecal Coliform Loads: Percent Reduction Required to Meet Wet Weather TMDLs

Watershed	Total			Point Sources				Nonpoint Sources			
	Existing Load	TMDL	Reduction Required	MS4		Caltrans		Ag/Livestock		Open Space	
				WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
San Joaquin Hills HSA/ Laguna Beach HSA ^d	705,015	664,634	5.73%	37,167	52.07%	179	0.00%	7,346	0.00%	619,942	0.00%
Aliso HSA	1,752,096	1,579,073	9.88%	477,069	26.62%	260	0.00%	26,508	0.00%	1,075,237	0.00%
Dana Point HSA ^d	403,911	377,313	6.59%	152,446	14.86%	13	0.00%	0	0.00%	224,854	0.00%
Lower San Juan HSA	15,304,790	14,714,833	3.85%	1,156,419	12.82%	1,713	0.00%	2,855,570	12.82%	10,701,131	0.00%
San Clemente HA	1,441,723	1,378,931	4.36%	192,653	24.58%	335	0.00%	366	0.00%	1,185,577	0.00%
San Luis Rey HU	33,120,012	32,444,242	2.04%	914,026	3.12%	1,537	0.00%	20,041,659	3.12%	11,487,019	0.00%
San Marcos HA	20,886	17,224	17.53%	6,558	18.98%	8	0.00%	9,073	18.98%	1,585	0.00%
San Dieguito HU	21,286,910	21,101,649	0.87%	798,175	1.46%	1,310	0.00%	11,698,811	1.46%	8,603,352	0.00%
Miramar Reservoir HA	10,392	10,256	1.31%	6,703	1.99%	0	0.00%	0	0.00%	3,552	0.00%
Scripps HA	204,057	176,907	13.31%	101,253	21.14%	0	0.00%	0	0.00%	75,654	0.00%
Tecolote HA	261,966	229,322	12.46%	126,806	20.47%	553	0.00%	0	0.00%	101,963	0.00%
Mission San Diego HSA/ Santee HSA	4,932,380	4,680,838	5.10%	221,117	53.22%	1,009	0.00%	414,721	0.00%	4,043,991	0.00%
Chollas HSA	603,863	520,440	13.81%	252,479	24.84%	892	0.00%	0	0.00%	267,070	0.00%

Table I-19. Wet Weather Total Coliform Loads: Percent Reduction Required to Meet Wet Weather TMDLs

Watershed	Total			Point Sources				Nonpoint Sources			
	Existing Load	TMDL	Reduction Required	MS4		Caltrans		Ag/Livestock		Open Space	
				WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
San Joaquin Hills HSA/ Laguna Beach HSA ^d	8,221,901	7,445,649	9.44%	880,652	46.85%	7,722	0.00%	50,774	0.00%	6,506,501	0.00%
Aliso HSA	23,210,774	20,190,798	13.01%	8,923,264	25.29%	11,003	0.00%	179,828	0.00%	11,076,702	0.00%
Dana Point HSA ^d	6,546,962	6,031,472	7.87%	3,404,008	13.15%	634	0.00%	0	0.00%	2,626,830	0.00%
Lower San Juan HSA	130,258,863	122,879,189	5.67%	16,093,160	19.21%	60,480	0.00%	14,946,372	19.21%	91,779,178	0.00%
San Clemente HA	16,236,606	15,147,603	6.71%	3,477,739	23.85%	13,534	0.00%	2,370	0.00%	11,653,960	0.00%
San Luis Rey HU	231,598,677	224,150,535	3.22%	14,373,954	5.62%	54,508	0.00%	110,768,160	5.62%	98,953,913	0.00%
San Marcos HA	515,278	425,083	17.50%	298,430	18.47%	533	0.00%	99,809	18.47%	26,311	0.00%
San Dieguito HU	163,541,133	159,814,184	2.28%	16,660,538	4.29%	47,969	0.00%	66,570,499	4.29%	76,535,178	0.00%
Miramar Reservoir HA	212,986	210,180	1.32%	171,436	1.61%	9	0.00%	0	0.00%	38,734	0.00%
Scripps HA	5,029,519	4,356,973	13.37%	3,447,764	16.32%	0	0.00%	0	0.00%	909,209	0.00%
Tecolote HA	7,395,789	6,379,770	13.74%	5,136,598	16.51%	27,095	0.00%	0	0.00%	1,216,077	0.00%
Mission San Diego HSA/ Santee HSA	72,757,569	66,105,222	9.14%	10,790,520	38.14%	53,141	0.00%	3,495,960	0.00%	51,765,601	0.00%
Chollas HSA	15,390,608	13,247,626	13.92%	9,880,784	17.82%	45,652	0.00%	0	0.00%	3,321,191	0.00%

Table I-20. Wet Weather Enterococci Loads: Percent Reduction Required to Meet Wet Weather TMDLs

Watershed	Total			Point Sources				Nonpoint Sources			
	Existing Load	TMDL	Reduction Required	MS4		Caltrans		Ag/Livestock		Open Space	
				WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
San Joaquin Hills HSA/ Laguna Beach HSA ^d	852,649	782,799	8.19%	66,417	51.26%	365	0.00%	3,201	0.00%	712,816	0.00%
Aliso HSA	2,230,206	1,950,964	12.52%	735,490	27.52%	516	0.00%	11,245	0.00%	1,203,713	0.00%
Dana Point HSA ^d	501,526	462,306	7.82%	219,528	15.16%	25	0.00%	0	0.00%	242,753	0.00%
Lower San Juan HSA	12,980,098	12,152,446	6.38%	1,385,094	27.12%	2,823	0.00%	839,040	27.12%	9,925,490	0.00%
San Clemente HA	1,663,100	1,563,187	6.01%	295,668	25.26%	635	0.00%	148	0.00%	1,266,736	0.00%
San Luis Rey HU	18,439,920	17,463,618	5.29%	1,300,235	11.69%	2,397	0.00%	6,077,514	11.69%	10,083,473	0.00%
San Marcos HA	40,558	32,966	18.72%	23,771	20.19%	26	0.00%	6,246	20.19%	2,923	0.00%
San Dieguito HU	14,796,210	14,307,087	3.31%	1,763,603	7.72%	2,288	0.00%	4,082,010	7.72%	8,459,187	0.00%
Miramar Reservoir HA	11,564	11,405	1.38%	8,109	1.93%	0	0.00%	0	0.00%	3,295	0.00%
Scripps HA	377,839	324,032	14.24%	232,035	18.82%	0	0.00%	0	0.00%	91,997	0.00%
Tecolote HA	708,256	603,761	14.75%	471,211	18.15%	1,266	0.00%	0	0.00%	131,284	0.00%
Mission San Diego HSA/ Santee HSA	7,255,759	6,590,966	9.16%	890,617	42.74%	2,430	0.00%	213,149	0.00%	5,484,770	0.00%
Chollas HSA	1,371,972	1,152,645	15.99%	802,918	21.46%	2,062	0.00%	0	0.00%	347,665	0.00%

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